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U. S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN No. 1719

IMPROVING *the* FARM ENVIRONMENT FOR WILD LIFE



IMPROVING THE FARM ENVIRONMENT FOR WILD LIFE

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INTRODUCTION

NEARLY EVERY FARMER delights in the lusty whistle of bobwhite from a nearby post, the cheerful song of the meadow-lark from the hay meadow, the rapid scolding calls of the killdeer as it swings about overhead, and the songs of many other birds, which he deems his friends and for which he invents picturesque names. Almost every farmer uses thoughtful care in protecting the homes of birds and animals, often taking great care to avoid destroying some tiny nest. No group of people more enjoys contact with living things than do farmers, nor is there any group from whom an appeal for wild-life protection will receive heartier response.

It is in the farmer's power to increase vastly the wealth of interesting creatures which, by sharing his property, bring him color, song, and sport. Most farmers find in this mere companionship sufficient justification for conscious effort toward the increase of wild life, but they need not forget that profits also are involved. Many of the wild creatures, for instance, are definitely allied with him in his battle against insect enemies, and others furnish salable recreation. Since, therefore, there are economic as well as esthetic factors concerned, the deliberate encouragement of many forms of wild life may be recognized as sound agricultural practice.

Despite their general interest, however, few farmers fully realize how directly every farm activity affects wild life. From dawn to dusk of each day the farmer's chores tend, each in its way, to make his premises a better or a worse home for feathered and furred creatures. The chopping down of a dead tree may mean death to a den of lively squirrels; the pasturing of a wood lot may eliminate a covey of quail; and the use of silos, the storage of manure, the drainage of marshlands, and many other parts of the farm routine may react profoundly upon the lives of songbirds, game birds, and fur animals.

Farm practice often can be modified so as to benefit wild things and yet in no way interfere with agricultural objectives. In fact, desirable bird and animal life on the farm may be greatly encouraged and multiplied by even minor modifications of agricultural usage. Nearly all farmers are interested in how this can be accomplished.

Wild-life management, particularly game management, is something essentially different from mere protection and preservation. Game management is a branch of agriculture, whereas preservation is much more a function of park and sanctuary administration. Preservation seeks to hold what there is, a laudable purpose, but one too frequently implying passive acceptance of present conditions rather than active efforts to better them. No farmer is interested merely in preserving his seed corn. No more need he be interested in preserving only a seed stock of game when he can, if he will, vastly increase and utilize it.

Furthermore, in reality it is not the lawmaker but the farmer who determines whether game may or may not be taken. If the farmer destroys the environment and with it the game, no one can take game even if there are privileges under the law. If game is present the farmer may permit hunting or he may prevent it by insisting on observance of trespass laws.

Although under the prevailing laws of the United States the farmer does not own the game, he nevertheless controls it, and without his active interest in its increase the hunting public and the lawmakers are powerless. It is evident that the millions of hunters in this country cannot be accommodated upon public property even by the most heroic efforts of game commissions in establishing public hunting grounds at great expense. By and large, the public must use the ordinary farm for its excursions after rabbits, squirrels, pheasants, and quail. To insure the continuance of that privilege it is incumbent upon sportsmen to observe every courtesy toward farmers upon whose lands they may have the privilege of hunting and to conduct themselves in accordance with the Golden Rule.

To make the farm fully productive of game is an agricultural process; use of the farm by the public, therefore, in harvesting the game crop demands recognition of costs assumed by the farmer in maintaining and paying taxes upon game coverts and in his donating a share of his other crops as food for wild life. Recognition of the financial aspect of the problem does not sordidly transmute the recreational value of wild life into gold or dollars; it merely faces the fact that practical efforts are necessary in the preservation and increase of game and wild-life environments on farms and that constructive labor merits reward.

The purpose of this bulletin, then, is to discuss how the farmer may encourage desirable wild creatures upon his lands, particular reference being made to game species, and also to consider what returns may compensate him for altering his premises and policies in favor of game and other wild things to a greater extent than would be justified as good agricultural practice if there were no compensation. Attention is given to what may be termed the indirect economic benefits resulting from the encouragement of wild life, as well as to the more direct forms of return.

With regard to lands taken out of agriculture and so-called marginal lands, this publication points out a use that can be widely adopted with benefit both to the farmer and the public; namely, production of revenue-yielding wild life. Marginal lands are not restricted to arid, rocky, or other generally nonagricultural regions. On the contrary they are present to some extent on most farms. Creek and ditch banks, rough spots, nooks where fences or other obstacles render cultivation impracticable, and other areas not being used may be devoted to wild life. If treated as suggested herein these areas will produce supplemental crops—fur and game—that may be the means of increasing farm income (pp. 58 to 60).

The recommendations here made do not apply to all farms and not necessarily to all parts of any one farm, but they do apply to areas where increase of wild life is recognized as desirable—and these should be far more extensive than at present. Some farming practices recommended differ from the "clean cultivation" ordinarily considered essential on all farms, but it must be recognized that clean cultivation and game do not go together. Wherever the presence of wild life is to be encouraged throughout a farm or on special parts of it, the practices here recommended are applicable.

REPRODUCTIVE CAPACITY OF WILD LIFE

The most important natural factor bearing upon wild-life management is the amazing reproductive capacity of living things. Many interesting calculations have been made to show in how surprisingly few generations, if unchecked, the cod would fill the seas, or the house fly, the rat, or some other creature would overrun the earth. Applied to game species on the farm, such calculations show that if a pair of cottontails, for instance, had complete success in rearing two litters of 6 young each season, there would be (assuming an even division of the sexes and no fatalities) 98 rabbits the second year, 686 the third, 4,802 the fourth, 33,614 the fifth, and so on. If a pair of quail had one brood of 14 chicks each season, there would be 128 birds the second year, 1,024 the third, 8,192 the fourth, 65,536 the fifth, and so on.

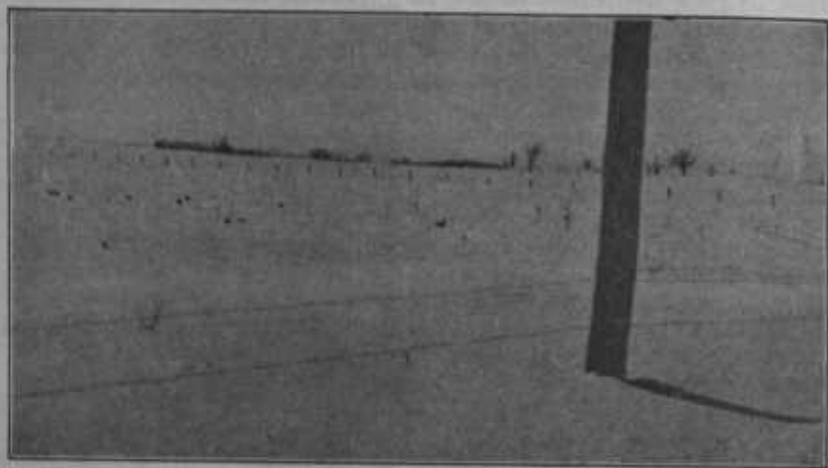
Thus, to aid efforts to increase wild life, there is available a reproductive force almost explosive in its intensity. Unchecked, there would soon be more quail, more rabbits, more of everything than the environment could support. Each kind of wild life, plant or animal, is trying to do the same thing; that is, to increase and spread indefinitely. Like the trees in a wood, however, in reaching for their place in the sun, the various groups overlap; the overlapping parts obliterate each other; and none attain complete domina-

tion. Man can do some planting or pruning, achieve some additions or eliminations, in Nature's realm, so as to favor desired groups at the expense of the undesired; this is the essence of wild-life management.

RELIEVING CHECKS UPON THE INCREASE OF WILD LIFE

Normally the increase of wild life is checked by natural wastage, by weather and accident, by predators, parasites, and diseases, and possibly at times by thirst or hunger; in other words, by pressure of other elements in the environment. To some degree we can reduce this pressure, and to the extent that we succeed we shall be rewarded by a more than normal increase in numbers of the groups we favor.

If not generally understood and accepted before, it was made clear in the report¹ on the cooperative quail investigation, directed by



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FIGURE 1.—The minimum in game cover and food. Hungarian partridges picking at the last of the available weed seeds in a locality almost devoid of winter cover. These birds had to be winter-fed. There were large losses in country of this type when feeding was not carried on.

the Bureau of Biological Survey in southern Georgia and northern Florida from 1924 to 1929, that the most effective as well as the most economical way of increasing the population of a game species is by improving its environment. Providing more food and better cover and lessening the pressure of natural checks result in an immediate increase in the game.

COVER FOR WILD LIFE

Cover is anything that provides a favorable retreat for wild life or offers it shelter or protection. Game cannot exist without suitable cover. Some species, the cottontail rabbit for instance, are so adaptable that they occur in many types of cover, ranging from grassy back yards of city dwellings to brier patches, and from north-

¹ The Bobwhite Quail: Its Habits, Preservation, and Increase. New York, 1931.

ern humid forests to the semideserts of the Southwest. Other species, for example the prairie chicken, are less adaptable, occurring only where there are extensive marshes or grasslands. Deer and



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FIGURE 2.—Deficient bobwhite cover, which could be made satisfactory by improving the hedgerow. The standing corn in the background, although used by both cotton-tails and quail, is so distant from cover that the game is much exposed to danger.

other larger animals require vast areas of suitable cover; while quail, on the other hand, may be accommodated by a single thicket or brushy fence row. Figures 1 to 3 illustrate, in order, almost total



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FIGURE 3.—Good farm cover for bobwhites, showing planted hedgerow, diversified woods with extensive borders, standing grain (background), and a good proportion of uncultivated land.

absence of cover, deficient cover, and satisfactory cover—all in farm environment. Table 1 shows the environment needed by some of the more common upland game birds and by rabbits and squirrels.

TABLE 1.—*Game chart for the average farm*

Species and region	Nesting season	Eggs or young	Environment
Bobwhite quail—east of the Rockies.	May to July	9 to 16	Moderate cultivation, with plenty of woods, thickets, vines, and fruits.
Ring-necked pheasant—Northern States.	April to July	9 to 15	Moderate to intensive cultivation; best with nearby marshes or swamps. Under ideal conditions these birds can exist on crop lands alone.
Prairie chicken—Corn Belt and the Southwest.	May to July	10 to 15	Very moderate cultivation. Large areas of marsh or grass, and farm of more than average size required. These birds cannot thrive where farming is intensive.
Ruffed grouse—Northern States and Alleghenies.	April to May	9 to 17	Ungrazed mixed woods required; reduction of woods under 15 to 40 acres drives these birds out.
Hungarian partridge—northern Corn Belt and the Northwest.	May to July	8 to 20	Cultivation required, hut thickets and other cover are used.
Cottontail rabbit—entire United States.	March to August	14 to 8	All habitats, but moderate cultivation and plenty of low coverts preferred.
Squirrels—Northern States..	May to June	4 to 6	Woods or forest.

¹ Probably 2 litters of this size.

COVER TYPES

Farm game cover may be classified as concealing (or confusion), shelter, nesting, and emergency cover.

CONCEALING COVER

Concealing (or confusion) cover is anything in the environment that effectually hides the game concerned. Such cover is essential to the game's sense of security, but what is sufficient for one species may not be adequate for another. All such cover should be thick enough to afford some degree of concealment, though it should not be so thick as to keep game from maneuvering easily. Where possible, concealing cover should be extensive enough to introduce the element of confusion. Who has not seen a hunted animal make its get-away in only moderately good concealing cover that was sufficiently extensive, however, to cause the pursuer to be uncertain in regard to which of several possible courses the intended prey had taken? Small patches of concealing cover are useful, though of less value.

SHELTER COVER

Shelter cover is that affording protection from the weather. Wild game in healthy condition and with plenty of food can withstand the elements well. Ruffed grouse dive under snow and make use of the snow itself for protection. Some other birds—the Hungarian partridge and the quail, for instance—make use of snow, too, and sometimes even enter deserted barns or similar artificial shelters during severe weather. Many wild birds and mammals resort to wooded swamps during blizzards. Windbreaks of various kinds, especially growths of evergreens, are of service to wild life, particularly where protection from wind is combined with exposure to sunshine, as on the south side of a wood lot.

NESTING COVER

Nesting cover varies greatly. Ruffed grouse require woodland. Hungarian partridges nest in fields of alfalfa, oats, wheat, and similar crops. Quail more or less favor roadsides, the margins of rights-of-way, fence rows, grassy fields, and a variety of similar nesting situations.

The cooperative quail investigation, carried on in southern Georgia and northern Florida, disclosed that of 602 nests of the bobwhite studied, more than half were in broomsedge fields (which correspond in a general way to the grasslands of the Northern States), 16 percent were in woodland, 14 percent in fallow fields, and only 4 percent in cultivated fields. It is probable that in the Northern States, with more intensive farming, there is a higher percentage of nests in cultivated fields. As a rule, such nests are made close to permanent cover.

In wild-life management, nesting cover must be carefully provided for. It is useless to attempt to change the habits of wild creatures; the environment must be adjusted to their requirements. Ruffed grouse, for example, will not move into fields to nest when their woodland nesting cover has been grazed out; they will either move away to some favorable woods or be eliminated by natural agencies. Thus, it is essential to know what the general requirements of game are before an attempt is made to manage specific species, but there are a number of broad principles that are applicable to the development of cover on practically all game-management areas.

EMERGENCY COVER

Emergency cover as here used means cover to which wild creatures can flee when pursued; it may be entirely different from other kinds. Rabbits chased by dogs dash into brush heaps or hollow logs; quail pursued by Cooper's hawks have been observed to take refuge in rolls of old fence wire; many species resort to brier patches, tangles of honeysuckle, greenbrier (also called cat brier), rose thickets, Osage-orange hedges, and other places that are similarly effective as barriers to their larger enemies. Emergency cover is extremely important, and where it is available in close proximity to food supplies, game will persist even in the presence of numerous natural enemies. Great care should be used to develop adequate emergency cover on farms where game is to be encouraged. On every such farm some cover should be thorny enough or dense enough to afford game added refuge from predators.

In table 2 is shown the value to wild life of several kinds of cover. The vegetation listed is meant to include not only the particular cover-forming species named, but also the general environmental association in which they ordinarily occur. This table is most applicable to the Northern and Eastern States.

TABLE 2.—An appraisal of cover useful to wild life

[Cover favorable to the increase of wild life is indicated by X; very favorable by XX; that also having both cover and food value¹ by F or FF; and that generally of low value by a blank (leaders). The appraisal is in each case an approximation, its application to particular localities being subject to wide variation.]

Cover	Value for—													Value against predators	
	Bobwhite quail	Ring-necked pheasant	Prairie chicken	Ruffed grouse	Hungarian partridge	Cottontail rabbit	Snowshoe rabbit	Fur animals	Squirrels	Woodcock	Jacksnipe	Waterfowl	Tree birds		Field birds
Ungrazed wood lots:															
Second-growth hardwood	FF	FF		FF		FF	FF	FF	FF	X			FF	X	XX
Mature hardwood	X	X		F	X	X	F	FF	F	XX			X	X	XX
Swamp hardwood	F	F		FF		FF	F	FF	F	XX			FF		XX
Hardwood and conifers	FF	FF		FF		FF	FF	FF	FF	X			FF	X	XX
Tamarack and spruce		F		FF		FF	FF	XX	F	XX	X		FF	X	XX
Young pine and spruce	XX	XX		FF	FF	FF	FF	XX	FF	X			FF		XX
Mature pine and spruce	F	X	F	F		X	X	X	FF	XX			FF		X
Aspen				FF		F	FF	X		X			X		X
Boxelder and cottonwood	X	X		X		X		X					X	X	X
Windbreaks, hedges, and fence rows:															
Osage-orange (untrimmed)	XX	XX			XX	XX		X					XX	XX	XX
Prickly-ash	XX	X		F	XX	XX		X	X				X	FF	XX
Wild plum, hawthorn	FF	FF	FF	FF	X	X	X	F	F				FF	FF	XX
Cherries, mountain-ash	FF	FF	FF	FF	X	X	X	F	F				FF	FF	XX
Young pine and spruce	XX	XX	X		XX	FF		XX	X				XX	XX	XX
Mature pine and spruce	F	X			X			X	FF				FF	FF	X
Arborvitae (untrimmed)	X	X		X	X	X	FF	X	X	X			FF	FF	XX
Redcedar	F	F		F	X	X		X	F				FF	FF	XX
Dogwood, serviceberry	FF	FF	F	F	F	X	F	F					FF	FF	XX
Sumac	F	FF	FF	FF	FF	FF	F	FF	X	F			FF	FF	XX
Briers and berries	FF	FF	FF	FF	FF	FF	FF	XX	F				FF	FF	X
Grassy fence rows	FF	FF	X		FF	F		FF					FF	FF	XX
Vines, with other cover:													X	FF	X
Wild grapes	FF	F	F	FF	F	FF	X	F	F				FF	FF	XX
Bittersweet	FF	F	F	FF	X	FF	F	X	X				FF	FF	XX
Virginia creeper	FF	F	F	FF	F	XX	X	X	X				FF	FF	XX
Japanese honeysuckle	XX	X		XX		XX		X	X				FF	FF	XX
Greenbrier	FF	F	F	FF	X	FF	XX	X	X				FF	FF	XX
Cultivated crops, etc.:															
Standing corn	FF	FF	FF		FF	FF		F	F			F	F	F	X
Shocked corn	FF	FF	FF		FF	FF		F	F				F	F	FF
Standing small grain	FF	FF	FF		FF	FF	F	XX	F			F	FF	FF	X
Small-grain stubble	FF	FF	FF		FF	F		X					F	FF	X
Ragweed, amaranth, etc.	FF	FF	FF		FF	F		X					F	FF	XX
Fallow fields	FF	FF	F		FF	F		XX	X				F	FF	X
Truck gardens	FF	FF	X		FF	FF							FF	FF	X
Orchards	FF	FF	F	F	X	FF		X	X				FF	FF	X
Wooded lawns	FF	F			F				FF				FF	FF	X
Vineyards	FF	FF	FF		FF	FF		FF	X				FF	X	
Berry patches	FF	FF	FF		FF	FF		FF	X				FF	FF	X
Red and white clover, alfalfa	FF	FF	FF		FF	FF		FF	X				FF	FF	X
Sweetclover	X	FF	X		FF	FF	F	X					X	FF	XX

¹ The value of coverts in providing foods taken by fur animals is usually indirect: for example, mice, preyed on by fur bearers, are found in grassy marshes, though the vegetation itself is not eaten by the fur animals.

² Not in dense stands.

³ Most of these have only seasonal value, or only portions near coverts are useable.

TABLE 2.—An appraisal of cover useful to wild life—Continued

Cover	Value for—														Value against predators
	Bobwhite quail	Ring-necked pheasant	Prairie chicken	Ruffed grouse	Hungarian partridge	Cottontail rabbit	Snowshoe rabbit	Fur animals	Squirrels	Woodcock	Jacksnipe	Waterfowl	Tree birds	Field birds	
Ungrazed marshes:															
Cattail		XX	FF			X		FF		X	X	X	X	X	X
Sedges	F	FF	FF		X	F	X	XX		X	X	F	XX	FF	X
Potholes	F	FF	FF	X	X	F		XX		X	X	F	XX	FF	X
Grassy marshes	F	XX	FF			F		XX		X	XX		X	X	X
Ponds and lakes:															
Shallow, well vegetated										F	FF	F	X	X	
Deep, little vegetation															
Streams															
Unclassified cover: †															
Brush heaps	XX	XX	X	X	X	FF	X	X	X				X	X	XX
Large thorny roses	XX	FF	FF	FF	X	FF	X	XX	X				X	X	XX
Untrimmed tree tops	XX	X	XX	XX	X	FF	FF	X	X				X	X	X
Woodpiles						XX		XX	X						XX
Hollow logs						XX		XX	X						XX
Hollow trees						XX		XX	X				XX		XX
Stone walls	X	X			X	FF	X	XX	X					X	XX
Straw stacks	F	F	F		F	FF		X	X				F	F	X
Wire entanglements	XX	X	X	XX	XX	XX	X	X	X				X	X	XX
Rail fences	XX	X	X	X	XX	XX	X	XX	X				X	X	XX
Culverts and tiles						XX		XX	X						XX
Old buildings	X	X			X	X		X	X						X

* In connection with other cover.

COVER MANAGEMENT

TOO MUCH COVER POSSIBLE

The value of plants for cover depends a great deal on local circumstances, rate of growth, and other factors, and there is such a thing as having too much cover as well as the more common fault of not having enough. In southern quail territory an interesting example of the value of cover at one stage of growth and its detrimental effect at a later stage is found in the case of the so-called "broomsedge." This grass (*Andropogon*) is sufficiently open for a couple of years to be inviting to quail; but its continued growth, combined with the accumulation of the debris from other years, eventually results in choking out all food plants, and such overdensity makes the sedge a habitat shunned by quail but attractive to many cotton rats (*Sigmodon*) and other undesirable animals. Such accumulations, furthermore, are serious fire hazards. Burning was found to be the best way of disposing of the plant; the best time to do this is during cool nights late in the winter. With plenty of men available to supervise such burning, this method is satisfactory. It has come to be an extensive practice on southern quail preserves, and not only improves conditions for game but gives better protection to timber.

A too-luxuriant growth of deciduous trees and shrubs in southern pinelands held primarily for quail shooting was also encountered in the cooperative quail investigation. In fact, any growth that shuts off so much light from the ground that the favorite food plants will not grow is undesirable.

In the North, in those rare instances in which the burning of cover is desirable (as, in burning off a dry marsh area that is almost certain to be flooded later on, thus preventing the nesting of game birds in a hazardous situation), it is frequently possible to burn safely just after the disappearance of snow. Where there is legitimate reason, marshes may generally be burned while still frozen.

DIVERSITY OF COVER

Uniform cover conditions tend to limit the number of species, or the number of individuals, or both, whereas diversification ordinarily increases the number of both species and individuals. This is merely another way of saying that a farm with wood lot, shrubbery, brushy gullies, hedgerows, pond, creek, wooded swamp, grassy swale, standing corn, standing sweetclover, and weeds, and with ordinary crop stubble, can harbor much more wild life than can a farm that has only stubble, only standing corn, or any other uniform environment.

DISTRIBUTION OF COVER

In addition to being diversified, cover should be distributed—but not too widely. If a quarter-section farm, for instance, has an excellent wood lot suitable for quail on the extreme northwestern corner, and a small field of standing corn on the extreme southeastern corner, with no cover between, neither cover nor food is of maximum availability. It would be better to have the corn and the wood lot close together, but if some sort of cover linking the two is provided, even though they are not close, their availability to wild life will be increased. It is, then, desirable to have coverts connected, or not too widely spaced.

The distribution of cover is particularly important as regards its location in relation to food. Cover without food is worthless. Dense shelter, food-producing range, nesting cover, and other necessities must be provided, and the more unit areas furnishing all these requirements throughout the year, the more coverts of quail there will be. This principle applies to all wild life.

There are numerous other considerations in distributing cover. Strip cover, for example—coverts arranged in long, narrow areas—is most valuable in summer; if dense enough, it is valuable at all seasons. Many other such details will be learned through experience.

Well-arranged coverts also increase the recreational value of hunting.

DEVELOPMENT OF COVER

With these cover requirements in mind, and having considered the general types of cover—concealing or confusion, shelter, nesting, and emergency—the kinds of coverts on the typical American farm ordinarily available to song, insectivorous, and game birds, and to fur animals may now be dealt with.

FARM WOOD LOTS

One common cover area is the wood lot. The 167,000,000 acres of farm wood lots in the United States have been recognized as valuable in producing fuel, lumber, and posts; in conserving moisture; in checking erosion; as windbreaks and snow fences; in the production of a number of products, such as maple sugar, Christmas trees, and wild nuts and berries; and in promoting general recreation. But heretofore, apparently, little consideration has been given to wood lots as game-production areas, though they contain most types of game coverts. The potential game production of farm wood lots, which average 24 acres to a farm—17 percent of our total farm area—is too large to be lightly dismissed; yet their potential production has scarcely been imagined, much less achieved.



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FIGURE 4.—An ideal farm wood lot (ungrazed), attractive to wild life and productive of useful forest crops. Compare with figure 5.

For one economic reason or another, as just outlined, or to make the farm a more attractive, enjoyable spot on which to live, it is profitable to extend wood lots to practically all waste places that are suited to forest growth and are submarginal for agriculture. In fact, it can be shown readily that well-managed wood lots (fig. 4) and their associated products are among the most valuable of farm crops and may contribute more to farm income than similar acreages of wheat, corn, or pasture. Information on wood lots is contained in Farmers' Bulletins 1117, Forestry and Farm Income, and 1177, Care and Improvement of the Farm Woods. Rocky fields, hillsides, gullies, and odd corners set out to trees should at least pay the taxes, and with the same kind of care given crops, they should yield a profit.

In a great many cases thoughtfulness of wild life will make it possible to handle the wood lot so as to encourage animals and birds and yet not interfere with the work. If the farmer cutting his winter wood, for example, remembers that the tops of maple, ironwood, and birch are delicacies for rabbits, he may postpone the burning of the brush heaps until early spring, well before the dry season. And if he does this, he will find trails worn down from heap to heap by the rabbits that are attracted to them. Later, when burning the brush, if he leaves a few heaps, in places where they will not constitute a fire hazard, the grass will grow up through them and they will form ideal resorts for rabbits and songbirds.



FIGURE 5.—The result of heavy grazing of the farm wood lot, unproductive even of forage; devoid of shrub-loving wild creatures; no reproduction of young trees; mature trees endangered by exposed and trampled roots. Although this illustrates the extreme condition, even moderate grazing is destructive.

And, if he piles his firewood on poles or logs, the woodpile will form an attractive shelter for rabbits, especially in fall and summer. There are, indeed, many ways in which wood lots can be made more productive of wild life. Some of these methods are considered in the following pages.

CONTROLLING GRAZING

The grazing of small farm wood lots by cattle, sheep, or hogs is ordinarily disastrous (fig. 5) to forestry or wood-lot perpetuation, because of the elimination of young growth, and is, at best, of questionable value from an agricultural viewpoint, because of the low forage value of wood lots. Light pasturing may not be especially destructive, but the tendency is always toward overgrazing. Furnishing livestock with shade, is, of course, a good use of wood lots, but shade can be provided without permitting cattle to eat all the

young growth, compact the soil, and injure the older trees. (See Leaflet 86, Protect Hardwood Stands from Grazing.)

Grazing wood lots kills many shrubs, trees, sedges, and berries that are important producers of the food so essential to wild life. The elimination of cover by grazing is so pronounced and its effect so serious that some kinds of game disappear within a few months after invasion of livestock. Almost all coverts are injured, and many are destroyed, by grazing.

Consequently, where game or other terrestrial wild life is a consideration, wood-lot grazing by livestock should either be entirely eliminated or confined to one small portion of the woods by means of a stock-proof fence. If this cannot be done, reasonably large areas within the woods should be fenced against livestock and allowed to grow up for the benefit of game. The planting of natural barriers, such as thorny trees and shrubs, would partially protect the wood lot against cattle.

PREVENTING FIRES

The importance of fire control in farm wood lots is obvious. Fire kills valuable young trees, destroys important foods of wild creatures, reduces cover, and often makes woodland uninhabitable to its former denizens. Fire at any time during the season for eggs and young is of the nature of a catastrophe in the bird and animal world, to be compared with earthquakes and hurricanes in relation to human beings. It should be a principle rigidly adhered to that fires be kept out of wood lots, marshes, and other game coverts, except in rare cases when controlled fires are used for specific purposes, under very careful supervision. In connection with wood-lot management, fire is sometimes of use. Legitimate uses include making small clearings, which may grow up to wild berries, or keeping combustible material within controllable proportions rather than allowing it to accumulate to the extent that it becomes a serious fire hazard. It cannot be too much emphasized, however, that uncontrolled fires are tremendously destructive. Under all ordinary circumstances, a running fire on a farm is a liability, even where set with good intentions. Fire has no place on game-management areas except as a tool in reducing vegetation, and then only when adequate precautions are taken.

DIVERSIFYING THE WOOD LOT

The principle of diversity is applicable within the wood lot as well as to cover in general. The greater the variety of trees, shrubs, and vines, the greater is the value of the wood lot as a home for wild life.

Grapevines, for instance, may well be encouraged in portions of the wood lot where they will not damage valuable trees. Where a vine is growing over a tree of little value, the tree may be cut down and the vine allowed to ramble over the fallen top, thus forming an ideal resort for quail and pheasants. Some such places should be in the borders and some in the interior of the wood lot. Virginia creeper and bittersweet should also be encouraged in the wood lot and on fences. If grown in quantities, bittersweet has commercial pos-

sibilities for decorative purposes. All these plants lend themselves to culture and transplanting, and may be increased as desired.

There should be a large variety of trees, and the trees themselves should be of different ages and sizes. A woods with uniformly large, mature trees could be much improved for most kinds of game by the clean-cutting of a few small areas, which would then grow up to brushy vegetation. Furthermore, uniformity in stands of tree species encourages insect damage, and diversified woodland is thus consistent with good forestry. Even hollow trees and stubs hollowed out by woodpeckers are valuable, and plenty of them should be left standing—or the hollow logs left lying on the ground. Squirrels, raccoons, chickadees, small owls, woodpeckers, and many other birds use the stubs, and rabbits and fur animals use the hollow logs. A few stubs are a good thing in any wood lot.



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FIGURE 6.—Good ruffed-grouse, snowshoe-rabbit, deer, and red-squirrel country. Conifers offer shelter and concealment, and stumps and brush afford emergency cover. This growth is young enough to have considerable food value for rabbits, deer, and grouse.

MAKING OPENINGS IN LARGE WOOD LOTS

Openings, clearings, paths, woods borders, and roads, because of the increased sunlight that they receive, are productive of shrubs, vines, grasses, and other valuable food-producing plants, and thus are of value to wild life (fig. 6). Anything that will increase these natural wild-life attractants is a practical game-management measure. There should thus be plenty of paths, openings, and trails throughout the wood lot—places where the sun can reach the earth, even in the thick woods. The value of such openings is shown by the fact that of the hundreds of bobwhite nests studied in the cooperative quail investigation in Georgia and Florida, 74 percent were within 50 feet of paths, roads, or similar open spaces in a denser environment.

On the other hand, if picnic grounds are to be made, the farmer should see that brush and other vegetation are cut out of a limited area only—just enough to afford ventilation and a view. The whole woods should not be denuded for this purpose.

When wood lots are being planned for wild life, it is well to bear in mind the advantages both of blocking woods in separate sizable areas (fig. 7) and of greatly extending borderlands. Blocking affords more sheltered sides or woodland lees, hence better protection from the elements, and by furnishing numerous coverts it gives a greater opportunity for escape from enemies. On the other hand, borders of woods hold most of the fruits, berries, and sunlight-loving plants that are attractive to game, and such borders can be extended profitably. The maximum shrub, vine, and berry growth is obtained by judicious use of the blocking system, with many indentations, arms, and openings.

It is well also to bear in mind the fondness of most wild birds and mammals for dusting. Ashes, dry earth, dust, the crumbling



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FIGURE 7.—This hillside, formerly unproductive and worn out, was planted to white pine in 1873. It sold for \$350 in 1901 and for \$1,000 in 1912; and thereafter its value continued to increase. An excellent type of winter emergency cover for quail and rabbits, but too small for ruffed grouse. The food supply could be increased by planting the stone-wall area in the right foreground to berries, grapes, or bitter-sweet, and having a small patch of standing corn. The borders could also be made more attractive for songbirds and fur animals.

wood of rotten logs, even ant hills, are used for this purpose. Deliberate effort may well be given to the provision of little sunny openings in deep woods, well supplied with dusting material, and to the provision of adequate dusting facilities about the borders. Dusting seems to be of use in ridding birds and mammals of external parasites, and accordingly it may be desirable at times to sprinkle some mild insecticide in the dust baths that are being used. Supplying many dusting places has the further advantage of preventing undue concentrations of game and the consequent greater risk of disease and parasite transmission. This matter should receive increased attention as the wild-life population rises on the managed area and as the possibility of transmission thus increases.

PLANTING EVERGREENS

Many wood lots are deficient in winter concealing cover and in windbreaks. Spruces, firs, and pines offer an excellent means of increasing such cover, especially where used in conjunction with thorny growths and low evergreens, such as juniper. Evergreens with Osage-orange, wild plum, prickly-ash, or the larger thorny roses also make excellent cover. Coniferous trees are valuable for a great variety of songbirds as well as for game.

If the farm lacks evergreens, it is well to plant some in the wood lot, in spots where shade is not too dense. It would also be well to dedicate an entire half acre or more to Christmas trees. If spruces of excellent quality are planted, it will be possible to harvest a portion each season after the fourth or fifth year and still leave enough to produce timber or fuel. For the maximum value to wild life, the Christmas-tree tract should be near the wood lot. Further information on this subject is given in Farmers' Bulletin 1453, Growing and Planting Coniferous Trees on the Farm.

PROVIDING WATER

Many birds obtain water from dew or in their food and are more or less independent of running or standing water, even though they make use of it when available. In general, tree birds are dependent to a great extent on free-water supplies. Some birds are definitely so dependent—the mourning dove, for instance, at least during the nesting season, as water is necessary for the yield of “pigeon milk”, the semiliquid, partially digested food that is regurgitated into the gullets of the young birds. Doves fly long distances for water and then return, but other species may forsake unwatered territory. Aside from the purely biologic necessity of drinking, water is resorted to by the birds for bathing and cooling purposes and is thus enjoyed much in the same way as it is by human beings. Most wild creatures are about as responsive to luxuries as people are and for their homes prefer places where these are provided.

The wood lot should, therefore, if possible, have water available at all times. Care should be taken, however, that the water supply does not constitute a trap where wild creatures can easily be picked up by their enemies. If the wood lot is not near a stream or pond it may be possible to introduce a dependable water supply.

WINDBREAKS AND THICKETS

The use of windbreaks and hedgerows varies with the locality. Some sections of the country, like the famed English countryside, owe their beauty and general attractiveness largely to growths of vegetation between fields, so useful in breaking the monotony of crop lands. Others appear drab through absence of between-fields greenery. Fence-row cover, wherever found, ranks extremely high in its wild life and game utility, and while windbreaks occupy acreage and reduce crop yield on adjacent strips, they also have advantages to farms, especially in sheltering buildings and orchards, in addition to their ornamental appearance and utility to wild life. The desir-

ability of increasing hedgerow growth depends much on the type of cover afforded, as some kinds have little and others much value from the agricultural standpoint. A food-supplying function may also easily be provided for, as Russian-olive, buffaloberry, and hackberry, all good bird foods, are highly recommended for windbreaks. Almost all types—whether shrubby bushes, berry plants, actual woods, weedy fence rows, or grassy tangles covered by grapevines and Virginia creeper—are of value to wild life.

The additional advantages of these are various. The wild grape, to mention one, will grow over dump grounds, stone heaps, stone walls, in gullies, and on steep hillsides, as well as in the wood lot, and once well established is an effective erosion-checking plant. Windbreaks and hedgerows can also be used to hide unsightly spots, such as dumping grounds or old machinery.

Windbreaks (fig. 8) in some instances have also been known to



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FIGURE 8.—Honeylocust windbreak in Nebraska. Good summer cover for bobwhites, Hungarian partridges, songbirds, rabbits, and fur animals. Winter value could be improved by underplanting with low evergreens and adding vine and shrub cover. A strip of unharvested hay and one of unharvested corn would make this covert of much greater utility, especially for ring-necked pheasants.

prevent grain from lodging or blowing over in the wind, and in sections where such damage is common they will thus prove to be of some value as wind insurance for crops. (See Farmers' Bulletin 1405, the Windbreak as a Farm Asset.)

Hedges and windbreaks when used should be pruned for dense, bushy growth. The hedgerow that has grown up, leaving the bottom open, is ineffective as a windbreak and of little use to ground game. Vines, shrubs, and berries should also be encouraged along fence rows and hedges, and for nest cover some grass should be left adjacent to hedges. Osage-orange, honeylocust, catalpa, plum, cherry, evergreens, prickly-ash, boxelder, cottonwood, or other species should be planted in accordance with recommendations of the State agricultural experiment station. Hollow logs or tiles placed at intervals

in the windbreaks and hedges will be used by rabbits and fur animals. To give wild life the best advantages of continuous cover, hedges and windbreaks should be connected with woods and marshlands.

SNOW FENCES

In recent years, thousands of miles of snow fences have been built in the Northern States for road protection. The same purpose can be served by planting windbreaks at the same distance from the road. In fact, a leading agricultural magazine has for years been advocating this method of handling the problem. Civic organizations are interested in the road-beautification aspect of such plantings.

WINDBREAKS FOR TIMBER AND POSTS

It has already been mentioned that the agricultural utility of a hedgerow or windbreak depends much on how it is managed and



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FIGURE 9.—Eroding farm land in Illinois. By means of revegetation, this waste area could be made productive of timber, fur, and game.

to what it is planted. It is perfectly feasible to plant hedgerows to trees suitable for post or timber production and also valuable to game. Posts are used on all farms, and they cost a considerable amount if purchased. Lumber and firewood, also, can be harvested in moderate quantities from hedgerows. One of the best timber-producing hedgerow trees is black walnut, while those ordinarily used for posts and fuel are catalpa, poplar, Osage-orange, and a variety of the more common ornamental trees.

VALUE OF THICKETS IN CHECKING EROSION

One of the significant results of too intensive cultivation is the increased rapidity with which soil is washed away by heavy rains (fig. 9). Even in the course of ordinary rains the gullyng of cultivated fields is enormous, particularly where the land is rolling.

It has been said by good authorities that the abandonment of many farms because of low fertility is due more to the washing away of the rich topsoil than to exhaustion by crops.

According to the Yearbook of Agriculture, 1928, p. 575—

Most of the worn-out farms scattered throughout the United States were not worn out by producing crops but because the owners did not take steps to prevent the washing away of the fertile topsoil. Many productive farms will join the worn-out class in a few years unless soil erosion is prevented.

Well-placed game coverts may be used for this purpose. In fact, among the most practical means of handling gullies and washes already existing upon farms is the encouragement or planting of vegetation to catch and hold soil. The same methods apply to drainage-ditch banks, exposed embankments, and road cuts, from which debris commonly washes down upon highways in wet weather. Even the creek and river banks subject to undermining by currents in flood times may often be held permanently by the regular planting of willows. These trees may be planted effectively if long willow poles or tree trunks, 2 inches or more in diameter, are used, half buried in trenches at right angles to the stream, the butts of the poles within reach of ample moisture. A systematic entrenchment of such poles, with due regard to moisture conditions, will frequently result in an astonishing growth of verdant cover and the eventual development of extensive soil-binding root systems, which finally defy the swiftest currents. Along smaller streams it is feasible to use branches and willow shoots, which, fortunately, take root rapidly where moisture conditions are favorable.

Willow is perhaps the most widely available and rapidly growing soil binder for lowlands; furthermore, it affords cover used by many small birds and, when in large clumps, by game birds. Willows overhanging creeks and streams also multiply the insect food available to fishes and increase shade, consequently keeping the water temperature more habitable for some of the colder-water fishes.

The black locust is another tree of great use in checking erosion. It also is a rapid grower, but is less dependent on moisture than are willows. It makes excellent posts and furnishes cover to a variety of birds.

Other useful agents in erosion control are sod-forming perennial grasses, briars, vines of several sorts, some of the more thrifty shrubs, and various trees, choice of which depends on the soil, moisture, and grade conditions, as well as on the objective. County agricultural agents and State agricultural colleges are generally able to furnish detailed information on the most effective local methods in various parts of the country.

Since few farmers would seriously object to a small expenditure that would at one and the same time provide dependable erosion insurance and an attraction to wild life, the control of farm-land erosion by the simple methods just outlined should come into more favor; but there seems to be wide-spread indifference to the dangers attendant upon erosion and ignorance of revegetative methods for use in its control. Information on remedial measures is available in Farmers' Bulletin 1234, Gullies and How to Reclaim Them.

MISCELLANEOUS ADVANTAGES OF BETWEEN-FIELDS COVER

Some advantages of fence-row cover are less susceptible of measurement. One of these is the role of windbreaks in protecting orchards from serious frost, discussed in Farmers' Bulletin 1405, previously mentioned. Frost does not generally hurt orchard trees unless it occurs after the trees have begun spring activity. Too early budding or flowering invites damage, and windbreaks can be utilized in screening orchards to such an extent that late budding and flowering are encouraged, thus putting these activities of the trees past the usual frost period. In summer, however, the temperature is raised in well-protected fields, owing to lack of evaporation and its consequent cooling effect. This condition can be used to advantage in maturing certain crops that need the benefit of every possible additional degree of temperature.

So-called "waste lands", as the term is applied to fence-row strips and odd uncultivated nooks about farms, may, as has been shown, be made productive lands, rich in fur and game, beneficial to growing crops, and themselves capable of producing crops of game and fur. "Waste lands" often can produce more income to the acre than areas cleared a few years ago and now devoted to low-priced standard crops.

Clean cultivation of actually tilled land is, of course, an essential element of good farming. Leaving, where possible, woods, hedgerows, marshes, and other between-fields cover is also good farming and a logical corollary of clean cultivation, as farms without some interspersed ground cover are not only devoid of beneficial wild life but also are more subject to erosion, lodging of crops, and the increase of destructive insects.

The following list summarizes the more common beneficial results to general agriculture from the extension and encouragement of between-fields coverts:

- Prevention of erosion.
- Conservation of moisture by snow storage.
- Protection of buildings from blizzards.
- Protection of roads by living windbreak snow fences.
- Reduction of wind-blown losses of soil.
- Protection of fields from stock.
- Increase of those beneficial species that prey upon insects destructive to crops.
- Encouragement of birds that eat harmful insects and destructive rodents.
- Protection of orchards from too-early spring growth and consequent later freezing.
- Production of farm timber and posts, of berry crops, and of sumac for tannin extract.

Although numerous indirect economic benefits accruing from the establishment and preservation of between-fields coverts have thus been pointed out, this discussion should not lead to the conclusion that such coverts are intrinsically so valuable, quite aside from their effect in increasing wild life, that the farmer who has established them merits no special consideration by hunters and by those who make regulations for hunting. Windbreaks and tall hedgerows occupy acreage that might otherwise be planted, reduce crops on adjacent strips, and harbor injurious as well as beneficial forms of plant and animal life. These adverse factors should be borne in

mind. A definite effort to give landowners who develop and preserve their coverts an increasingly large share of responsibility and ownership in the game thus encouraged is necessary to stimulate further covert development and assist in the legitimate use of a heretofore-neglected type of agricultural crop.

ORCHARDS

Old-time orchards were ideal places for birds and other wild life. The tree cavities furnished nesting sites for some, clumps of apple suckers and bushy fence rows favored others, and weedy growth provided cover for numerous forms of wild life. With the cover came natural supplies of food in plenty.

Tidying up the orchard decreases its value to wild life, and modern clean culture and top-notch care almost exclude the wild birds and mammals. Bird houses can be put up on poles, however, and some forms of winter feeding adopted. A New York pear grower found that pieces of suet fastened in the trees attracted nuthatches in such numbers that they consumed practically all the hibernating pear psyllas—serious pests of the orchard. Chickadees, titmice, small woodpeckers, and other winter birds that can be similarly provided for, search diligently for insect eggs, scale insects, and other orchard-enemies. Encouragement of such allies certainly will repay any orchard owner.

The apple tree that holds its apples in fall and winter is attractive to many birds. Robins that remain in the North, sometimes live partly upon hanging apples, even in winter. Cedar waxwings, grosbeaks, starlings, and ruffed grouse also feed on them. Russets have especially persistent fruit, and one or two of these trees in the orchard will be well worth while.

An old apple tree with a cavity in the trunk is worth saving for birds. It can be cut off above the hollow and a new tree planted nearby instead of cutting the old one off close to the ground. After serving as a bird home for a few years, it can be removed. In replacing old fence posts, it is well to put in a new post but leave the hollow one for bluebirds, wrens, and other cavity-nesting birds.

At the time of cultivating orchards the farmer can make them more attractive to birds by planting sweetclover or small grains to be left unharvested. In addition to checking the growth of weeds and preventing erosion in the orchard, these will furnish food and cover for wild birds and animals. Seed of such cover crops may be disked in.

If rabbits are damaging the orchard in winter, it may be well to try feeding them away from the orchard, instead of killing them. In many cases rabbits are driven to orchards because the only readily available food supply is there. When pruning orchards, it is a good plan to pile the pruned branches in coverts so that the cottontails will feed on these instead of on the trees. The uneaten parts can be burned in spring.

ORNAMENTAL SHRUBBERY AND TREES

The season-long succession of flowers and the year-round show of ever-changing colored fruits that can be had by judicious planting

of shrubbery are sufficient reasons for such planting on the farm. The utility that shrubbery has for wild life, however, is an important additional urge.

Ornamental shrubs and trees provide a large part of the food for wild mammals and birds and many nesting sites. In farm plantings, it is especially necessary to bear in mind certain undesirable traits of shrubs, such as the connection between buckthorn and oats rust, barberries and wheat rust, redcedar and apple rust, and currants or gooseberries and white-pine blister rust. Wild cherries furnish nurseries for tent caterpillars, pests of orchards. In general, therefore, these shrubs should not be planted in regions where the injured crops are cultivated. There are, however, a host of satisfactory substitutes.

Recommendations regarding the kinds of shrubs adapted to various regions are contained in the following Farmers' Bulletins: No. 621, How to Attract Birds in Northeastern United States; no. 760, How to Attract Birds in Northwestern United States; no. 844, How to Attract Birds in the Middle Atlantic States; and no. 912, How to Attract Birds in the East Central States. The landscaping phase of shrubs and tree utilization is treated in Farmers' Bulletin 1087, Beautifying the Farmstead.

Fruit and nut-bearing trees can be planted as individual specimens for ornamental purposes or merged in wood lots, windbreaks, and thickets to improve the coverts from the standpoint of the welfare of wild life.

In the course of the southern cooperative quail investigation it was found that plum thickets were havens of refuge for the birds and that each thicket, if adjacent to suitable nesting and feeding areas, could be made the headquarters for a covey of quail. Through research in Wisconsin it was learned that thickets in draws and gullies, in addition to moderating erosion on farming lands, are of vital importance to coveys of quail.

Another interesting feature of game-planning work brought out by the cooperative quail investigation was the fact that although food might be produced in abundance, it might easily become unavailable. For example, pine seeds, or "mast", might fall in ground cover so dense that they could not be found by quail. Inasmuch as these birds rarely or never fly into the trees to procure such seeds, better results were achieved, so far as game was concerned, by preserving trees in places where the ground was fairly clear, as in a pasture adjacent to good cover. For this reason, an isolated fruit and nut-bearing tree, even though in a grazed pasture or other exposed place, frequently plays an important part in furnishing food to wild birds and animals, and should not be cut down merely because it is not surrounded by good coverts.

ROADSIDES

In many parts of the United States, roadsides are shorn of their vegetation at least once a year, either as a result of local sentiment or of legal requirement. Consequently, many country roads are very uninviting in summer. Hot and gray with dust, these highways stretch out before the traveler, often without a single tree to break the monotony of the view or afford relief from the rays of the sun.

Fortunately, there are also in this country examples of well-kept parkways and boulevards (fig. 10) bordering cultivated lands. Their ample parking is grown to grass and embellished with herbaceous flowering plants, shrubs, and trees. Yet the farm lands they border are neither overwhelmed by weeds nor devastated by insects and rodents. Placing vines upon fences and planting numerous shrubs and shade trees along the way will not only render the roads more attractive (fig. 11) but will tend to keep down the dust. Roadside plantings are discussed in Farmers' Bulletins 1481, *Planting the Roadside*, and 1482, *Trees for Roadside Planting*.

There can be no doubt that suppression of roadside vegetation is a potent factor in restricting the number of birds, and the ever-



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FIGURE 10.—A roadside attractively developed. Particularly good for songbirds, but of some use for quail and pheasants. (Photo by Wayne County (Mich.) Board of Highway Commissioners.)

increasing tendency to allow fence rows the minimum of space has the same effect. Farmers may gain a planting row about every field by the destruction of vegetation along fences, but they lose the services of the birds, their best allies in fighting insects.

Shrubby fence rows are among the best harbors and nesting places of small birds, and it is certain that encouraging an abundance of birds to live on farms is a profitable policy. More should be done to beautify roadsides and fence rows, not only as a measure contributing to the comfort and pleasure of man, but also as substantially increasing a great economic asset—the bird population of the country.

COVER IN RELATION TO PESTS

WEED PROBLEMS

So far as the relation of windbreaks, hedgerows, and thickets to noxious weeds is concerned, it should be pointed out that many weeds

are not shade resistant and die out in thicket growth, and the roots of many are not able to withstand the competition of grass roots or sod. It is also of interest to note that some of the prairie States, which have many large areas without any between-fields cover, have the most serious weed problems. Where weeds do occur locally in numbers in windbreaks or hedges, cutting the weeds prior to seeding time will keep them from adding more seeds to the already abundant supply.

One common objection to weeds is that they have no productive use, but many, such as ragweed, amaranth or pigweed, lambsquarters, and smart weeds, materially increase the food of wild birds and animals, and hence are really useful in their place. Ragweed, though objectionable as a cause of hay fever (see Leaflet No. 95, How to



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FIGURE 11.—Roadside bordered by elderberry. Illustrating how highways may be made attractive to man and wild creatures alike.

Control Ragweed, the Principal Cause of Autumn Hay Fever), is of primary importance as a winter food for quail. It follows cultivation but does not come into full growth until after harvest time. Patches left near cover will feed many birds. The plant holds its seeds well, stands up in the snow, and is a staple food of song and game birds. If due care is taken to prevent unreasonable spread, patches of some of the less harmful weeds may be deliberately encouraged for bird use. This, of course, does not apply to such extremely obnoxious weeds as the Canada thistle and Russian thistle.

RODENT PESTS

Grassy and brushy areas left between fields for bird cover should not be allowed to become dense and matted, as this type of cover not only is less favorable to birds but also is likely to harbor and favor the increase of rodent pests. In addition to menacing adjacent crops,

rodents may become serious food competitors of game birds and destroyers of their eggs. Also, the presence of numerous rodents attracts a proportionate number of their enemies among snakes and predatory birds and mammals, and these incidentally may also become destructive to the eggs and young of ground-nesting birds.

Cotton rats in Southern States and meadow mice generally are especially responsive to favorable habitats, such as are afforded by areas of dense broomsedge, brier thickets, and other cover that provides them protection and food. In such cases they may do serious damage to adjacent crops. Cotton rats have also been known to destroy bird eggs. House rats sometimes take advantage of the protection afforded by overgrown ditch banks and fence rows, even far from human habitation, and in such situations they may become destructive to the eggs and young of birds.

Poisoning rodents is often indispensable to successful propagation of beneficial species on noncultivated areas. Information concerning the most practical methods of destroying rodent pests can be obtained by writing to the Bureau of Biological Survey, United States Department of Agriculture, Washington, D.C.

INSECTS

Hedgerows and other cover types provide homes for many insects, some of which are pests.

Cover, however, does much to justify its maintenance by harboring some of the most important groups of insect enemies, our beneficial birds. Thickets, hedges, roadside cover, and grass areas, all play an important part in making a place attractive to birds. In fact, the brown thrasher, the catbird, kingbird, goldfinch, many warblers, the quail, and a number of other beautiful and attractive birds are ordinarily found in thicket cover, but generally not where it is absent. The extension of thickets between fields is a practical way of enticing valuable birds out into the crops, as they range to either side of the cover. Cuckoos, for example, which eat "furry", or hairy, caterpillars, will follow such hedgerows extensively, but will not follow field borders if there is no shrubby or wooded cover. Pheasants, Hungarian partridges, quail, prairie chickens, and, in fact, most of our game birds, are fond of grasshoppers, corn billbugs, and many other destructive insects. The birds should therefore be enticed into crop areas by an attractive environment. Unlike man-made agencies of control, birds continue their activities throughout the seasons, and they work in and through crops where man cannot go. The downy woodpecker has been seen taking borers from cornstalks in winter, thus contributing toward a good crop the following summer.

Scores of instances are known in which birds have suppressed local outbreaks of insect pests, and while their work in insect control is not always so spectacular, it is a steady aid that the farmer should always encourage. It is certainly good agricultural practice to maintain an environment that will attract and hold the birds that are such effective enemies of insect and other pests.

The word "insect" should not bring to mind only a vision of destructiveness, for many kinds of insects are beneficial to man. For instance, one useful service performed chiefly by insects is the pollination of fruit and other crops, which is necessary to their productivity. An example among field crops is the red clover, which is most often pollinated by the bumblebee, a common insect that is little appreciated. According to the Yearbook of Agriculture, 1928, p. 524—

In many localities there has been an alarming decrease in the amount of seed [red clover] set from fields where large yields of seed were expected. This decline may be attributed to a decrease in the bumblebee population, brought about by extensive campaigns to clean up fence rows, the plowing of permanent meadows, and the clearing of wood lots, all of which measures tend to decrease the number of bumblebees' natural homes. A continual decrease in seed production in the future may be expected where such activities are carried on.

Other sorts of useful insects find shelter in the comparatively undisturbed cover, among them some that combat injurious insects. It was recently shown, for instance, that in Wisconsin the ravages of a pea aphid, or louse, that sucks the sap from the growing vines of cannery peas and attacks other crops, were much less severe, and in some cases practically negligible, adjacent to open woodland. Such cover harbored syrphids, or flower flies, which are important enemies of the pea aphid. The effectiveness of the protection extended a considerable distance from the cover.

MARSH AND WATER AREAS

GENERAL VALUE

Drainage in agricultural districts has been carried on so systematically that the farm with marsh, pond, or perennial stream is exceptional. The scenic advantages of water, however, are universally admitted, and there is no other one thing that permits, or of itself brings, such a diversification and abundance of plant and animal life. Many of these forms are of economic importance to the landowner. All are of interest to him and to his family. Early in spring a pond may draw down from the skies some of those mysterious voyagers, the waterfowl; a little later flocks of swallows with airy circling and graceful dipping will so weave a maze of flight as to charm all beholders; in summer, a rail or coot, or even a wild duck, may bring forth from the reedy margin a fluffy brood that will be the pride of the farmer's heart; in fall, the muskrats may be seen building the conical houses they will need for winter shelter; and in winter the frozen marsh will reveal after every snow a fascinating story of the movements of both furred and feathered wild life.

The farmer who has provided for water areas has also solved his stock-watering problem, but in using this advantage he should guard against gross pollution, if threatened. Similarly, if he keeps domestic ducks in any number, their pond should be isolated to prevent pollution of other water supplies. Such action is especially important where ice is to be harvested, but the water supply should be kept clean for the sake of wild life as well. It will be more productive of wild life of every kind, including fishes, if uncontaminated.

IMPROVEMENT OF AQUATIC ENVIRONMENTS

MARSHES

Marshes of almost any size are of value to wild life, but they can be quickly ruined for this purpose if freely ranged by hogs or cattle. If the marshes must be devoted in part to domestic animals, effective fencing should preserve a fair share of the total area for wild life. If one or more ponds are present, or can be made by damming the drainage channel or by dynamiting in the body of the marsh (a simple process), much greater improvements can be made for wild life. (See the discussion of ponds, p. 28.) In all cases where the marsh tends to dry up in summer, the channel should be dammed sufficiently to prevent that calamity to all life dependent upon it. The fine fall and winter cover should not be destroyed by burning. If fire must be used, the marsh should be burned early in spring.

A wet, grassy marsh can be transformed in whole or in part into a wood lot by setting out tamarack, black or red spruces, or other moisture-loving trees. Spruce is used for many purposes, including posts and pulp, and tamarack has many farm uses. Converting half of a grassy marsh of large extent into a wood lot and leaving the rest as it stands, or adding some willow, alder, and red-osier dogwood, will literally make the area a paradise for game and fur animals as well as for songbirds.

Cattails and bulrushes usually are present in marshes; they are good cover plants for the nests of red-winged blackbirds, rails, coots, bitterns, and ducks, and their roots provide first-class muskrat food. Barnyard grass (called also wild millet, water grass, and numerous other names) often is present as a weed about marsh borders. It is a good food plant for a variety of wild life, is easily propagated, and the seed is cheap. Information on the improvement of aquatic environments by propagating duck foods may be found in Department of Agriculture Bulletins 205, Eleven Important Wild-Duck Foods, and 465, Propagation of Wild-Duck Foods. The Bureau of Biological Survey will supply applicants with addresses of dealers in wild-duck food plants.

STREAMS

Streams are improved for wild life if pools or quiet reaches are made to alternate with ripples or small rapids. If not naturally present, these can be provided by installing a series of rude partial dams or other obstructions. Small marshes can be made at the edges of the slack-water portions by a little excavation at such points. In general, food for the larger forms of aquatic life is produced in the quiet places, and its overflow to the more open moving water is a source of subsistence depended on by the numerous creatures that forage there.

A trout stream can be improved by supplying plenty of overhanging vegetation, which serves (1) to lower the temperature of the water to a degree more habitable for trout; (2) to add more insect food for the trout; and (3) to provide refuge places. Willows are excellent for this purpose, and also make good game cover. In

woods, the dogwood and the cranberrybush (sometimes called high-bush cranberry) may be planted. Willows may be started by cutting "whips" in spring and sticking these, cut end down, in moist soil. (For planting larger willows see p. 19.)

Streams with soft bottoms in quiet water at a depth of 1 to 5 feet and with fair exposure to sunlight, can be stocked with some of the more valuable aquatic plants, such as wild celery, and sago and other pondweeds. In certain cases streams can be impounded to form ponds.

PONDS AND LAKES

Muskrats, mallards, teals, rails, terns, and shore birds, as well as many songbirds, delight in the small pond or shallow lake. With an adjoining marsh (provision for which should be made where it does not already exist), a pond or lake furnishes or can be made to furnish all the essentials of existence for most of the forms of wild life of aquatic environments; in general, marshes provide cover, and ponds forage. A little work with plow and scraper will pave the way for a marsh at the margin of any pond. Marsh vegetation will come naturally to such a place, but progress can be hastened by transplanting, which often can be done from nearby sources. Such marshes should be protected by fencing when necessary, for grazing is destructive and should not be permitted there. The pond, if not already well stocked with plants, can be planted to a number of good duck-food plants, which are described, together with methods of propagating them, in the bulletins previously cited (p. 27).

The wild life suited to these areas will recruit itself. A marsh of even diminutive proportions will tempt a pair of red-winged blackbirds to nest. These birds are a colorful addition to farm life during a long season. Though muskrats do not require extensive areas, their presence should not be encouraged near root crops. Rabbits, pheasants, and quail use marshes more or less, although they do not ordinarily breed there. As marshes grow in area and in depth, rails, coots, bitterns, and even wild ducks come in. Where an increase of Wilson's snipe (jacksnipe) is desired, a closely cropped clover sod growing among sippy hummocks and hollows should be encouraged. Muddy flats also are attractive to jacksnipe and other shore birds. Geese like to rest on sand bars. If the pond does not have a sand bar and is fairly shallow, one may be built up over a nucleus of rocks, in a place where the geese can rest in isolated comfort. On some game refuges this has been done to advantage.

Waterfowl may be considered a prize among farm wild life, and the aid of farmers in reestablishing colonies of these birds over a vast breeding range now largely deserted would be a wonderful step in insuring their preservation. These birds learn quickly where they are unmolested. There are few more interesting groups of birds to observe, and hundreds of individuals can be drawn into ponds of very small size if protection and food are provided. Colonies can be started by placing pinioned pairs on the ponds or by having domestic ducks hatch the eggs of wild stock. Once started, such colonies persist with only a little feeding. Regularly fed, they can, where they occur in numbers, be depended upon as a source of farm income through the disposal of shooting privileges, if the birds are

kept wild enough. Feeding must not be overdone, however, or the birds will tend to lose their wild form and vigor; its real use in this connection is to cause a strong attachment to the home pond. In general, the ducks should be encouraged to forage for themselves. Some wild ducks domesticate readily, and for this reason it is especially desirable that colonizing efforts be attempted only with the best of wild stock, free from any domestic mixtures, and that attempts to make pets of them be discouraged.

Snapping turtles are duck destroyers, often killing the ducklings, and the larger "snappers" even overpower and eat adult ducks. Shooting with a .22-caliber rifle, seining, and trapping are recommended for turtle control. (See Farmers' Bulletin 1612, Propagation of Aquatic Game Birds.) Turtles lay their eggs in sandy spots during spring and summer, sometimes making extended migrations for this purpose. Although skunks and other fur animals eat these eggs, systematic search and destruction of them by man is a desirable means of control.

The various herons, or "cranes", and the bitterns that are found in wet areas should not be molested. Their food consists mostly of undesirable fishes, crawfishes, frogs, tadpoles, mice, and aquatic insects, some of which eat small fishes or fish spawn. Destruction of herons to improve fishing is almost always ineffective. Moreover, these birds are protected by Federal law.

The pond or lake is not a place to dump rubbish, and such dumping is contrary to law in many States. Old machinery, cans, glass, and junk should not be hauled out upon the ice and left to sink out of sight when it melts. Pollution in any form should be avoided. Sewage should not be diverted into small ponds or lakes; it endangers human health and is a menace to wild life. Cannery, creamery, filling-station, or oil wastes should never be diverted into waters that are expected to harbor birds, mammals, or fish.

Most States have laws or regulations affecting the propagation of game birds, and many require game breeders to take out licenses. In addition, Federal permits are necessary for lawful possession of wild ducks, wild geese, swans, and other migratory game birds in captivity. Federal permits are obtainable through the Bureau of Biological Survey, United States Department of Agriculture, Washington, D.C., as are also the addresses of officials to whom application should be made for State licenses and for the full text of State laws relating to the propagation of game birds.

CULTIVATED CROPS

The 370,000,000 acres of cultivated crops in the United States afford one of the most suitable of wild-life environments, though for various reasons they are comparatively little used by the creatures of the wild. The value of these lands for birds or animals varies with the crop, the methods of handling it, and the locality. By and large, it must be said that the crop environment does not ordinarily have a high population of wild life except in portions adjacent to good coverts (fig. 12). In most cases, also, where this fortunate proximity of cultivation and covert exists it is only by

chance. Inasmuch as a general increase of wild birds and animals upon farms is of direct benefit to agriculture, it is surprising that so little has been done toward promoting those farm practices which benefit wild creatures and at the same time are practical from the cropping standpoint.

RELATION OF FARM PRACTICES TO WILD LIFE

No single factor is more important for wild-life welfare than farm practices. Songbirds, game birds, and fur animals exist on farms only where farm practices preserve their homes, provide dependable food supplies, and afford protection from natural enemies and man. The farmer who wishes to encourage valuable wild life on his premises need not seek help beyond his own fences. Enough



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FIGURE 12.—Winter in a northern cornfield. Conditions all too common: Little or no winter cover; and food largely unavailable. In the center of the picture, Hungarian partridges may be seen at the base of a corn shock. The best method of winter feeding for these birds would be to open up one or more of the shocks. Cover could be afforded by constructing a tepee of cornstalks.

of the essential factors are already within his control to give him power to increase or reduce the numbers of practically every kind of bird or animal on the farm.

CULTIVATION AND HARVESTING

The far-reaching effects upon wild life of farm practices are shown by the abundance of the ring-necked pheasant in parts of the Corn Belt. Investigation shows the number to be greatest in areas where farming methods afford birds the best combination of food, cover, and protection. In South Dakota, for example, where much of the eastern part of the State is given over to large-scale production of corn, it is the common practice to turn cattle and hogs into picked or standing corn to feed until severe weather. With literally miles and miles of standing corn in South Dakota, a great quantity is available for the pheasants. Furthermore, even where the corn is first harvested, either by machine picker or by hand, and the live-

stock are not turned in until picking has been completed, many small nubbins and a great quantity of spilled grain are available to the birds throughout the winter.

There is little natural cover in much of the eastern South Dakota farm environment. Pheasants depend largely upon standing crops for their cover, perhaps the most important of which is the corn with its associated weeds. Standing corn, then, furnishes the birds both food and cover, particularly where the fields are fairly weedy, as is often the case in large-scale farming. Such farming practice has proved capable of maintaining a large population of pheasants, larger probably than that in any other State. Investigation has shown that pheasants do considerable good by feeding on insects; furthermore, these birds may serve as a source of delicious food for the table during the open seasons, in these ways repaying the farmer for the grain they have eaten.

In some other Corn Belt States the system of farming includes the production of milk and dairy products. This involves intensive utilization of corn for dairy feeding. The practice is to put as much of the corn in silage as the farmer has facilities to handle, and to haul the rest of the crop from the field shocks as needed. There is practically no late standing corn in most of the silo region, and in many counties by midwinter there is even very little shocked corn in the field. Consequently, the ring-necked pheasant either is absent or lives in restricted areas of natural cover, subsisting largely on natural foods, which usually are not abundant in the intensively farmed areas. It is apparent, then, that the same crop that produces an excellent environment for pheasants under one method of handling may be of much less value under another.

The practical application of this information is to modify agricultural practice slightly where it is desired to increase pheasants. Farmers have found that leaving a half-acre patch of standing corn adjacent to the farm wood lot or to an unburned marsh brings a pleasing increase in the pheasant or other game-bird population. Some of the shocked corn might also be left in the fields, the shocks opened to afford refuge to game in case of emergency. Even such a slight modification as the hauling of shocked corn first from those fields farthest from cover, leaving the shocks next to woodland and marsh until the last, has a great influence upon the welfare of game. So also, starting the harvesting of hay or small grains in that part of the field farthest from cover and working toward the cover, instead of driving game into the center of the field by circling it, will be an easily arranged benefit to the birds. The small amount of grain eaten is negligible, compared with the advantages obtained from having the birds about.

Practically all farm crops have some value to wild life if handled with this purpose in mind. Hayfields and small-grain fields are commonly used for nest sites by quail, pheasants, and Hungarian partridges, as well as by meadowlarks. Sweetclover, corn, sorghum, sunflowers, and miscellaneous crops afford good summer cover, and if patches are left standing they give cover protection and some food to game and small birds even in winter. Strips equal to one or two widths of the harvester left uncut adjacent to cover are not much

missed and mean a great deal to the wild life of the farm. Stubble is noted as a fall gathering spot for many game birds, attracted both by waste grain and by grasshoppers, which may be plentiful in it. Stubble can be made more useful as cover if the cutters of the harvesting machines are set high, or a "header" machine may be used if the straw is of no particular value. Measures for decreasing the mortality caused by farming operations are discussed on pages 42 to 44.

In some cases the farmer will be able to benefit directly both himself and the birds by planting sweetclover. It is an excellent soil builder, helps to smother weeds, checks erosion, and makes good forage. It furnishes some food to numbers of birds, and makes excellent cover for pheasants and other game. It may be planted (1) next to corn that is to be left standing, (2) next to any good natural cover, (3) along roadsides newly graded, (4) around or in old gravel pits, (5) in eroding gullies, washes, and wind-drifting soils, and (6) in any other places on the farm that are not being cropped and that are not intended for trees, windbreaks, or hedges. Sweetclover is sometimes planted with corn, left in the field through the winter, and plowed under in spring; this is excellent for wild life during the most critical season of the year.

Some clover may be profitably grown for seed, as considerable red-clover seed is still imported. Seed crops are not cut until later than ordinary hay, and this gives game an opportunity to rear young and get them away before cutting time. If possible, the seed clover should be arranged in long strips next to cover instead of in one large field.

Orchards are among the best of environments to be found for songbirds upon farms, and gardens are another favorite bird resort. Mention has already been made (p. 29) of the added value as game harbors of crops bordered by woodland, marsh, weedy field, or other permanent cover.

Where green manuring is extensively practiced for soil-building and other purposes, fields so used may become the main dependence of game birds and thus result in a material increase in their numbers. A definite rotation system for each group of fields, or better still for each group of farms, may easily be worked out, and the soil-enriching process greatly assisted, by planting nitrogen-fixing crops, such as clover, peas, soybeans, vetch, alfalfa, sweetclover, or any of the other leguminous crops recommended by the State agricultural college for the locality in question. It should, of course, be remembered that these green-manure crops should not be plowed under at a time when plowing endangers nests, and that the value of the fields may be much enhanced, from the wild-life standpoint, if ample strips are left unplowed until spring. Such areas may be the most commonly used of farm nesting sites and afford almost ideal conditions for birds rearing young, provided the fields do not become too densely overgrown. They are resorted to in winter as places of refuge and plenty and by careful planning may be made a most important means of maintaining soil fertility and at the same time producing a crop of wild life.

Idle weedy fields, if not too dense, often have considerable value as feeding and breeding places for game and insectivorous birds.

In this connection, it is well to emphasize again the importance of diversification. Where farming operations are carried on with wild-life and game development in mind, it is well to arrange the fields in long narrow strips, rather than in solid blocks, the strips extending within reach of all available cover types on the property. In this way one can obtain even within restricted areas, the maximum diversification of nesting, shelter, and emergency cover, as well as of greens, grains, and insects. The strip system was effectively developed by the cooperative quail investigation, in the course of which deliberate effort was made to border the strips with good cover. Alternating cover and crops in long strips really multiplies by many times the number of quail-covey ranges available on a given property. How far it may be carried on the ordinary farm will depend upon objectives and the presence or absence of diversified conditions at the start.

A list of farm practices that may be favorably modified for game and other wild life is found elsewhere in this bulletin (p. 42). Reference to it will suggest many other practices subject to improvement from this standpoint. In general, it can be said that pheasants and Hungarian partridges are exceptional in their ability to survive on highly cultivated land; most game birds require more cover than is afforded by ordinary farm crops alone. By taking full advantage of the natural areas remaining on the property, however, and by arranging the cropping practice with the game potentialities in mind, nearly every farmer can increase greatly the wild birds and animals on his farm, without in the least handicapping his production of the more staple agricultural commodities.

INCREASING THE FOOD SUPPLY FOR WILD LIFE

NEED FOR A CONTINUOUS, UNFAILING SUPPLY

Not only is food one of the most important factors affecting wild life, but fortunately it is also readily susceptible to control. Though the wild-life food supply can be increased to any desired extent, it is pitifully true that on the average American farm it is extremely scarce, at least during critical periods, as late in winter. Maintenance of an abundance of wild life in general or, more concretely, of a resident form like the bobwhite, depends upon unfailing continuity in the food supply. There must be food on the farm at all seasons, for if even one season is barren, wild life must seek sustenance elsewhere. The food supply must be a year-long chain, with no weak link.

In some cases, though the natural food is abundant, birds are unable to procure it. The cooperative quail investigation noted, for instance, that much of the native-legume seed, an important natural food of quail in the Southeastern States, fell into and through the dense mat of broomsedge and grasses that covered the soil, and could not be obtained by the quail, which are relatively weak-footed and inept at scratching. A certain type of ground cover (see p. 9) can thus result in partial to almost complete wastage of the excellent foods produced. The condition must in many cases be corrected, if the wild-life food supply is to remain ample. On northern farms it is probable that such wastage is most pronounced in marshes grown

up to dense sedge and grass, in fallow fields left uncultivated 2 or more years, and in woodlands that have accumulated a dense mat of fallen pine needles. Plowing and disking in intersecting strips is probably the best means of control, particularly as a rich volunteer growth of food-producing plants is often obtained on the turned strips. Where ample precautions are taken, fire can be a most effective tool in controlling such ground cover, but its proper use calls for full knowledge of its effects upon various types of vegetation. It may be possible to burn narrow strips through woodlands when the dew is on the vegetation, but the fire must be kept slow and of reasonable size.

SUMMER FOOD

The summer foods of wild farm birds and mammals consist largely of insects, fruits, berries, and succulent green vegetation. Summer, barring drought, is a season of plenty. Nevertheless, wild things have their preferences and, regardless of a general condition of plenty, are attracted to spots where their favorite foods occur. Successful game managers see to it that fruits and berries are available in a considerable variety and abundance. Insects are favored by dense vegetation and a plentiful water supply, and on farms for upland game birds the rearing fields for young birds are specially planted and managed to produce an abundance of insect food.

FALL FOOD

Many insects continue to be available to game until fairly late in fall, and dry grapes, fall-ripened berries, acorns, and some greens are to be had in that season in considerable abundance. By midfall, however, the food supply is largely beyond natural replenishment; future consumption is taken out of stock. Consequently, it is essential that an adequate stock be on hand to last through the winter and spring. It commonly happens that the supply of naturally stored food, in the form of weed seeds, dormant insects, dried berries, grains, and greens, diminishes rapidly until it is almost entirely exhausted, or until snows and other climatic factors make it unavailable. By the advent of real winter, farm food supplies for wild life are frequently seriously deficient, a condition all the more regrettable in view of the ease with which they can be increased. Fruit-bearing shrubs holding their crop over winter are available; they can be provided in any quantity, and the gain in food production for wild life is permanent.

WINTER FOOD

After winter has set in it is common for wild birds and animals to be faced almost daily with the serious problem of getting enough to eat. Some fur animals and other mammals evade this difficulty by hibernating, existing upon the fat stored up from fall, but song and game birds do not. Even for the muskrats in the marshlands, winter may be a severe ordeal if the water supply is deficient or other factors are adverse.

Game wanders to some extent in times of stress, and if it must leave the farm on which it has been living to search elsewhere for supplies of food, that farm loses thereby, for if game succeeds in

finding a place with a good food supply, it is likely to remain there. Wandering for food, however, often is not successful, the birds failing to find any more favorable situation than they left. Some individuals die outright when the food supply is low, pinched off by cold and storm as their constitutional vigor becomes reduced through hunger. Hawks and owls carry off others that if properly nourished would be able to escape. Without the warmth and vigor produced by food, wild creatures are at the mercy of the elements and their enemies. All the eliminating agencies of nature combine to destroy the individuals that lack food or are otherwise weakened. On the other hand, if cover and food are ample, climatic factors may be negligible, although in exceptionally unfavorable years they may cause a somewhat reduced yield. Sound wild-life management demands the saving of birds and animals that would otherwise perish, increasing them, and later putting them to whatever use may be desired.

WINTER FEEDING

Winter feeding is one of the most effective game-conservation measures at the disposal of farmers or game managers. It has be-



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FIGURE 13.—A patch of standing corn left for game by a Wisconsin farmer. Prairie chickens, ring-necked pheasants, and winter field birds and rabbits were feeding here just before the photograph was taken. This feeding station is a little too near buildings and is none too large. It would be more useful if near good cover.

come a standard practice with game commissions in various parts of the country. In the past much of it has been of an emergency nature, often wasteful and ineffective because done without advance preparation and consideration of the difficulties involved. Too often emergency feeding is attempted at a time when all transportation is difficult and laborious, or even impossible. Yet one can plan in advance and avoid such difficulties. (See Miscellaneous Publication No. 159, *Winter Feeding of Wild Life on Northern Farms*.) Moreover, farmers and resident game managers have a strategic advantage of location that the best of intentions and even substantial sums of money cannot obtain for nonresident conservationists. Planned winter feeding of game, in fact, can be a very simple process, easily and effectively done by any farm boy or other person interested in increasing wild life. Some of the most effective ways of feeding are to provide unharvested standing corn (fig. 13)

near good-cover; shocks of unhusked corn, which are opened regularly and reconstructed in tepee fashion; unharvested small grains; and unthreshed small grains left in the sheaf and stored for the purpose.

All these provisions are simple. Sheaf grain can be set out in the snow, and grain to be left standing can be planted in places where feeding will be most effective. Standing, shocked, or sheaf grain (corn, wheat, buckwheat, sorghum, millet, and other small grain) is preferable to loose shelled grain. If shelled grain is used, it is well to construct corn-shock or brush shelters, providing both shelter and food and at the same time plenty of openings for escape in emergencies. Greens, such as alfalfa-leaf meal, hay screenings, or lettuce scraps, will generally be relished by winter birds. A small plot of winter wheat will also supply a green food attractive to many. In years of great abundance of certain grains, those for which there is most likely to be an unmarketable surplus can be used, and thus help, even if only in a small way, to maintain satisfactory price levels. Careful planning should characterize all feeding operations, with due attention, where local conditions are known, to areas subject to heavy drifting of snow and to those usually affording the more favorable exposures. Advantage should be taken of windbreaks, sunny exposures, south-facing hillsides, packed roads, and other favorable features. Food should be provided regularly, and the supply should be dependable over long periods; deficiencies are cumulative, but even a day or two without nourishment may prove serious.

It sometimes occurs, particularly on areas managed for game birds, that if there is too great an abundance of rodents, including rabbits, squirrels, and mice, much of the winter feeding supports these species rather than the game birds. Here, too, planning is necessary, and the situation may be anticipated and thus easily handled, at least when rabbits and squirrels are troublesome, by permitting adequate hunting upon the property during the regular open seasons. As to mice and rats, mention has already been made of the advantage of encouraging beneficial hawks and owls (which also assist in checking rabbit and squirrel increase), and this subject is further treated elsewhere (p. 44). Where the small-rodent situation in field and orchard demands more serious attention, poisoning operations, as recommended in Farmers' Bulletin 1397, Mouse Control in Field and Orchard, may be necessary. In this case, strychnine is preferred, as poultry, quail, pheasants, and other gallinaceous birds are resistant to its effects. This partial immunity does not extend, however, to other birds; hence, care should be exercised at all times; poisoned baits can be put out in containers that only small rodents can enter. To make sure that the food supply is dependable, the farmer must also keep livestock away from feeding stations, by fencing if necessary.

Emergency feeding measures, when required, may include shoveling through the snow to the earth and scattering grain on the exposed ground; building brush or cornstalk-tepee shelters and placing grain inside; distributing shelled grain on hard-packed sled roads where automobiles are not common; or taking other steps that local conditions may suggest.

In sections affected by the corn borer, sheaf grain is recommended, or ears of corn impaled upon spikes driven through boards, which are then set upright in the snow. Ears of corn may be hung from barbed-wire fences, in hedgerows, or from limbs in good brushy growth. Conscientious cooperation with State and Federal agencies in corn-borer eradication should at all times be maintained. In many cases those in charge of such work will be glad to help devise satisfactory methods of feeding game, if a conflict in practices exists.

The winter feeding of small birds is used as a means of keeping them about orchards, where they destroy numerous hibernating insects. It is also done by many people to bring birds to a convenient place (often a window shelf) for observation. Suet is the principal attraction for birds of carnivorous tastes, such as the woodpeckers, nuthatches, chickadees, and creepers; and bread scraps, scratch feed, and sunflower and other seeds for the granivorous birds, including juncos, song sparrows, crossbills, finches, and many others. Fruit eaters sometimes will come to quartered apples, soaked raisins, or partially dried grapes. Directions for winter feeding of small birds are given in farmers' bulletins referred to on page 22.

As ornamental shrubbery can be made to serve the dual purpose of providing beauty for man and food for birds; so, also, can some of the cultivated flowers. Sunflowers, goldenglow, cosmos, and related plants hold their seeds fairly well and are greatly relished by various birds. Other common flowers of value to seed eaters are princessfeather, love-lies-bleeding, forget-me-nots, and poppies. Millets are excellent for planting to feed wild birds.

SPRING FOOD

Spring makes available some fresh greens, and during this season there are also to be had fallen seeds and some insects that were previously covered by snow. Early in spring, however, it is surprising how dependent many birds are upon grain. It is good practice to keep some grain available until the advent of the new generation of insects. In well-diversified game country the spring food supply is usually ample, but where more uniform conditions prevail, spring foods are likely to be deficient. Game coverts, for maximum spring utility, should have many nut- and seed-producing trees, berry patches, greens, and an abundance of insect-harboring vegetation. It is to be remembered also that by spring some hard foods ordinarily will have been softened enough to be usable even though earlier they were not edible. Cherry pits, which in summer pass through the birds entire, are eaten freely and the inner meat digested early in spring when cracked in the sprouting process. Many fallen berries and other fruits, which were passed by late in summer and fall, are also picked up in spring. The corky Japanese barberry is an example of a fruit not taken in fall but eaten in the softened condition it attains in spring.

It is well also to remember that threats to growing crops by game birds during this season can usually be taken care of without driving the game clear off the farm. If pheasants, for instance, concentrate upon a sprouting cornfield and cause local damage, a little corn soaked overnight and scattered over the ground in

the worst areas will generally check the damage at slight cost, without destroying the birds. With the interest of the birds in mind, the farmer will be able to find similar measures for dealing with other emergencies of this sort. Often, adequate food resources on uncultivated areas will be all the protection needed for crop lands.

INCREASING THE NATURAL FOOD SUPPLY

PLANTING

It is fortunate that wild creatures utilize many of the same trees, shrubs, and vines that are so highly prized by people for ornamental use, for it is possible to accomplish farm adornment and wild-life attraction at the same time. Though many of our ornamental plants bear seeds and fruits that do not supply wild birds and animals with food throughout the entire year, plantings can be made in such a manner that the fruiting seasons overlap, and thus food may be made available throughout the year. Moreover, valuable food plants will volunteer in the waste places of every farm, if these are protected from grazing and fire, or in some cases, if sod-bound areas are plowed.

Anyone would rather live on a farm where birds are abundant than on one having only a few. The presence of trees, shrubs, and vines, by attracting bird life, will add color throughout the year. Dumping grounds, full of tin cans, wire, and refuse, as well as quarries, gravel pits, old cellars, and other unattractive spots may be screened by planting trees and shrubs, which birds and animals also appreciate. Any improvement that increases human happiness is worth while, and the planting of trees and other plants that are both ornaments and sources of food for wild life is certainly one of such improvements. Lists of trees, shrubs, and vines that may be used for these purposes in various sections of the northern part of the country are given in the farmers' bulletins referred to on page 22.

Among the shrubs most valuable in producing food for wild life are the junipers, bayberries, spicebrush, sassafras, blackberries, dewberries, raspberries, roses, chokeberry, hawthorns, sumac, dogwoods, huckleberries, blueberries, elder, snowberries, blackhaws, and honeysuckles.

Among fur animals, the foxes and skunks eat a variety of berries, and it is probable that other species ordinarily not thought of as eating fruit may do so on occasion. To illustrate how generally certain foods are taken, it may be said that there are definite records of 118 varieties of birds eating raspberries; of 106 feeding on elderberries; 86 taking the fruits of dogwoods; 77 eating wild grapes; 93 eating sumac berries; 67 eating blueberries; and 33 feeding on hawthorns, or thorn apples; a catalog that could be extended in similar vein to great length. More detailed information on the preference of birds for various genera and species of food-producing plants is available in farmers' bulletins suitable for various regions and indicating the fruiting periods for various sections of the Northern States (see p. 22).

Of trees, any of the nut bearers, such as hickories, walnuts, butternuts, beeches, and oaks, are a boon to squirrels; maples, boxelders,

tuliptrees, and ashes have winged seeds that squirrels, mice, and birds feed upon; and the fruit-bearing trees, such as the redcedar, hackberry, mulberry, hawthorns, flowering crabs, wild cherry, wild plum, holly, and tupelo, often known as sour gum, cater to a variety of wild life.

Pine mast is a good source of food for bobwhites, as well as for crossbills, grosbeaks, and other nongame birds; larches, pines, and other conifers also are attractive to these smaller seed eaters; and alders and birches produce seeds eagerly sought by siskins, redpolls, and goldfinches. Ruffed grouse use the buds of many hardwood trees, including the beech, aspen, maple, birch, alder, and hophornbeam, or ironwood. Cottontail and snowshoe rabbits eat young shoots and bark. In fact, rabbits sometimes damage orchards and nurseries, and care must be taken in such localities not to increase rabbits unduly or else to provide adequate protection for the trees. Directions for rabbit control are contained in Farmers' Bulletin 702, Cottontail Rabbits in Relation to Trees and Farm Crops. As already mentioned, rabbits can usually be thinned out if public hunting is permitted on infested areas.

ENCOURAGING VOLUNTEER GROWTH

The cooperative quail investigation worked out a number of methods applicable in the South whereby a volunteer growth of wild native game foods is obtained by stirring the soil at the proper season. Land plowed or disked late in summer, for instance, and left unseeded to crops, produced wild plants different from those in similar plots plowed in midwinter, and both of these types of vegetation differed from that in plots plowed in spring. The principle involved is that the soil is literally filled with thousands of seeds of many kinds, dropped in years gone by, but these seeds germinate only when influenced by the sun and other factors at precisely the proper time. The wrong time for one kind of seed may be just the right time for another.

Too little work has been done in the North to permit detailed recommendations for obtaining volunteer foods suitable for winter use, but it can be said that ragweed is one of the most extensively eaten and nutritious of game foods, being taken by quail, Hungarian partridges, prairie chickens, pheasants, and songbirds. It has the ability to stand up through snow and retain its seeds, and it readily volunteers on rich lands that are fall-plowed, especially on lands that have in the past been put to wheat and other small grains. Ragweed is probably the most abundant plant that follows the wheat harvest on many farms, often growing up from the cut stubble and maturing its seed before winter. Where winter feeding of game is desired in its simplest form on ragweed-producing soils, the leaving of a strip of wheat uncut will ordinarily result in a luxuriant development of tall ragweed plants that will withstand snow.

It should be pointed out that ragweed is the most troublesome of several scores of plants whose pollen induces hay fever, causing, according to the Public Health Service, 90 percent of the cases of autumn hay fever in the eastern United States. Control is thus desirable near human dwellings, especially near those containing people susceptible to this disease. In many places, however, ragweed

may be utilized safely for food for wild life. The weed often makes its greatest growth after the planted crop has been harvested. Many present-day crops have originated from wild seed-producing varieties of plants, and ragweed may eventually be developed as one of the most important crops on lands managed for upland game-bird production.

The extensive grassy marshes so common in the Midwestern States, sometimes situated in great stretches of forest or, perhaps more frequently, occupying undrained depressions between agricultural lands, can also be improved for wild life. It is frequently noted that such grass or sedge marshes, although they afford much cover of a rather too uniform type and are occupied at certain times by pheasants and prairie chickens, especially, are remarkably barren of foods and thus do not constitute coverts that can be occupied the year round, at least by large populations of wild life. Where they are situated within practicable flying distance of weeds and grains, they may be used more or less constantly by game birds; but where these marshes are large and somewhat remote from agricultural lands, they are notable for the absence of such birds. It is probable that freeing some of the higher areas of these marshes from the sod, which prevents the growth of food-bearing plants, would permit increased production of food, and consequently make such places more livable for game birds. Some planting of grains and legumes in plowed areas also might well be made. Small grassy marshes do not require such treatment, but with tracts of large extent, the need for diversification and for an increased food supply becomes more apparent.

All the native legumes, or pod-producing plants, deserve consideration as foods for wild life, as their seeds are favorites with upland game birds. Not enough is yet known about certain varieties to justify recommending their use other than for experimental purposes, but partridge-peas, hogpeanuts, vetches, and soybeans are commonly found in quail stomachs. Among other plants, smartweeds, bristle grasses or foxtail grasses, and berries are known to volunteer after the ground is stirred, or in some cases, burned. Clover can be brought into almost any upland field or reasonably sunlit woods in the clover belt by stirring the soil and scattering seed, or by working in these areas with horses that are fed on clover hay containing good seed. The encouragement of clover is a practical step on tracts managed for upland game birds. Snowshoe rabbits, cottontails, and deer also are fond of it. Observations often will reveal other good food producers that will volunteer after the soil has been disked or dragged.

PROTECTING WILD LIFE

The kind and degree of protection it is desirable to extend to wild life on any farm necessarily depend largely upon the preferences of the landholder, but also upon the public interests, particularly as expressed in laws and regulations. Some owners will wish to afford equal protection to all wild life, an attitude that would let nature take its course. Many will want to exercise preferences among species by discouraging, for example, English sparrows, crows, or red squirrels, or encouraging the purple martin, the house wren, the gray squirrel, or other species. Others will desire to increase the bob-

white, the pheasant, the cottontail, and other game species. Preferential treatment of certain forms usually involves some degree of control of others, particularly predators. Protection of wild life on the farm, however, involves more than discouraging natural enemies.

Available information indicates that more than 50 percent of all upland game-bird nests on the ordinary American farm are destroyed by one agency or another. The most exhaustive figures on this subject are those obtained by the cooperative quail investigation in Georgia and Florida. Of a total of 602 nests studied, it was found that only about 1 out of every 3 was successful. Studies have been conducted, particularly in the North, of the destruction of the nests of other game birds, notably the ruffed grouse, the prairie chicken, and the Hungarian partridge, and in each case it was found that the destruction of nests was enormous. The same thing is experienced in England with pheasants and partridges, and a large increase of birds is obtained there by protecting every nest that can possibly be found.

The destruction of nests of song and insectivorous birds from all causes is even greater than that cited for upland game birds, often amounting to 70 percent or more. The losses among the young birds of both groups are also enormous, and there is, of course, some degree of mortality among the adults.

Less is known about the mortality among mammals, but it seems to be high. This is known to be true of rabbits. In general, mortality in wild life is greatest among the young, and it tends to increase in proportion to the number of young produced. In wild-life management the important thing is to increase the percentage of survival and to lengthen the average life span of individuals.

Listed in what is believed to be their approximate order of importance in the Northern States, the main agencies responsible for the usual destruction on farms of upland game birds (including eggs and young and adult birds) are: (1) Farming machinery and farming operations; (2) predatory wild animals; (3) domestic animals, including dogs and cats; (4) hunting; (5) climatic factors; (6) birds of prey; and (7) infectious and parasitic diseases.

No claim, of course, is made as to the accuracy of this listing other than in a very general way. Offhand it may seem that this is not the correct order of importance—that hunting is a much larger factor, or that predators are less important. Mortality is greatest, however, in the earlier stages of the birds' lives, and the chief causes in those stages are therefore the most important. Destruction of eggs alone accounts for 50 percent or more of the total mortality. If all agencies effective up to the fall season take half the young hatched from the remaining 50 percent of the eggs, it is evident that hunting and all other factors combined take their toll out of a population that is only one fourth or one fifth of the original number of eggs. This is not to say that hunting may not often be the largest factor in the destruction of the adult birds. The game manager, however, must consider percentages of hatch, nest survival, young survival, and all the other factors that determine a net increase or decrease in the fall population of adult birds. The larger factors of destruction

(1 to 3 above) operate more or less continually all the year, and the problem must be handled with this in mind.

It should be remembered, also, that the above discussion omits consideration of the most important factor of all in determining net increase or decrease (even though it may not cause direct mortality); namely, change in the physical environment. If the farm pond, which produces several broods of wild ducks as well as other aquatic birds, is drained, the resulting change in environment may cause a 100 percent decrease in the population of aquatic birds, so far as that farm is concerned. In fact, this very thing has happened on so many farms that it has resulted in a material decrease in the waterfowl resources of the Nation. The same thing has occurred, although perhaps less spectacularly, on much of the former prairie-chicken range, and the process, unfortunately, is still extending to other of our most valuable species of wild life. It is clear that though protection from machine, beast, and gun will accomplish something, attention must be paid to the fundamental conditions of environment.

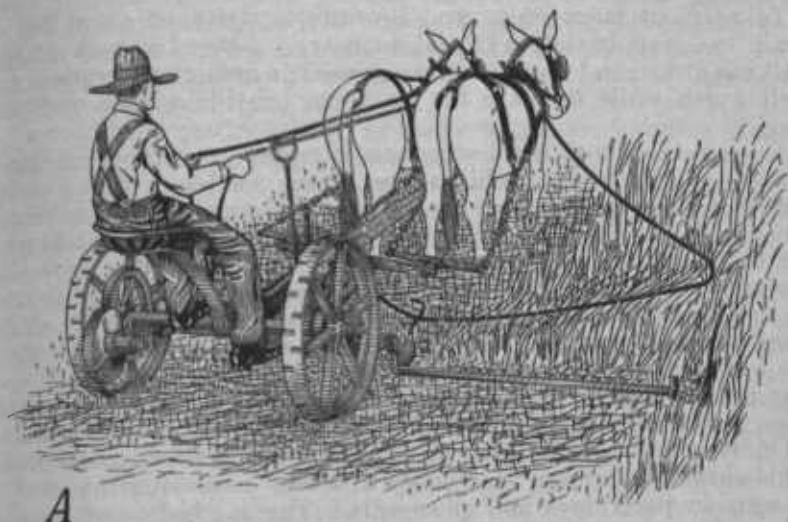
DECREASING THE MORTALITY CAUSED BY FARMING OPERATIONS

The regularity with which farming operations destroy upland game-bird nests is not appreciated except by those who have systematically canvassed fields behind machinery. If harvesting is done early in the season, some of the birds dispossessed will make a second nest, particularly if incubation has just begun; later in the season, the nests destroyed may themselves represent second and probably final attempts of the birds to rear young.

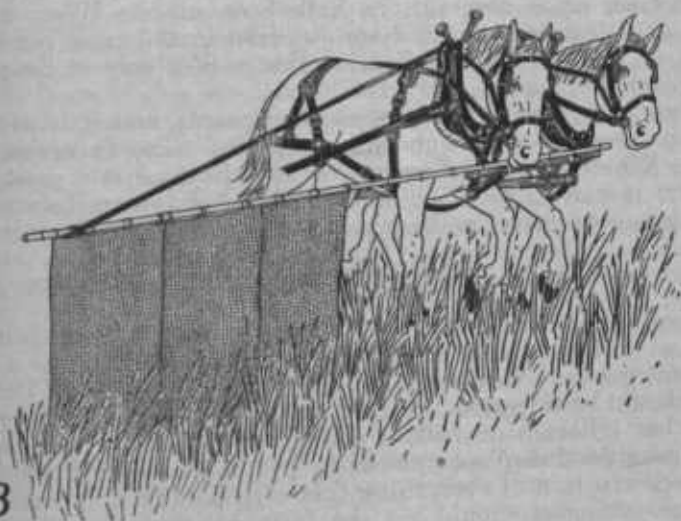
Upland game birds, and field-nesting birds in general, often show a distinct preference for nesting in crops closely adjacent to fence rows or cover. This cover itself is a much used highway for enemies, and although many birds are raised every year in fence rows, it is probable that the fields are safer so far as natural enemies go. Hence, it is not uncommon to find nests comparatively concentrated in the several rods adjacent to fences, woods, marshes, and other good environments. Since so many nests will be found in growing crops, farm practice should be modified with this in mind, where game is regarded as a crop. For example, when harvesting grain and mowing hay in fields bordered by cover, the farmer can leave the close-to-cover part to the last. He can also safeguard many nests and give game an opportunity to get into cover without injury, by using a flushing bar like one of those shown in figure 14. Where seed is to be saved, it may be taken from selected parts of several fields instead of all from one; the additional time the seed hay is left in the fields, even if only a few days, frequently enables young birds to hatch and leave.

It is also possible in harvesting the smaller grain and seed crops, where straw is not of any particular use, to set the machinery so as to cut higher than usual, the object being to mow or cut above the nest, or to leave cover about it, so that the incubating bird will return if the eggs are not destroyed. The additional straw left on the field also has some fertilizing value. The use of header machinery on farms managed for game would be a practical step, as these machines leave almost all the straw standing in the field.

Much interest has recently been shown in various types of flushing bars that can be attached to mowers or reapers to flush ground-nesting birds before the cutting blade destroys them or the cover for their nests. If the machine is halted and the sickle lifted after the



A



B

FIGURE 14.—Flushing bars: A, The Gopher Camp Fire Club flushing bar; B, the Iowa flushing bar. (Courtesy of the American Game Association.)

bird flushes, so as to leave an "island" of cover over and around the nest, the chances are this will not be deserted.

Two types of flushing bar are shown in figure 14. The Gopher Camp Fire Club flushing bar (fig. 14 A) is made of $5/16$ -inch soft iron, one end looped and the other welded to a 2 by 6 inch plate in which two $3/8$ -inch holes are drilled. The drilled end of the bar is bolted to the tongue near the mower, and the looped end is fastened

to the hames. A simpler device, the Iowa flushing bar (fig. 14 *B*), consists of a bamboo pole extending out from the neck yoke and supporting burlap sacks that are slightly weighted—with links from old tire chains, for example. The outer end of this bar is supported by a strap attached to the hames.

In years of large crops and low prices strips of uncut hay or grain can well be left adjacent to cover. Later livestock grazing will put it to good use; or where game is a real consideration, it is well worth while to leave the strips to provide winter cover and food.

In connection with the destruction of nests by machinery it should be remembered that machines are often needlessly driven across pieces of waste land, over fence rows, and through fallow fields and other such places. Short detours to avoid these areas may prevent the destruction of some hidden nests. If game increase is the important object, machinery should not be used on certain favorite nesting grounds at all. Hand harvesting of corners that are almost certain to harbor ground-nesting birds is worth while, although on the general farm these and other practices with the same end in view may not be feasible. They are important and practicable considerations, however, where wild farming of game is being undertaken.

On European game preserves keepers systematically search the fields ahead of farming machinery to avoid destroying the nests of Hungarian partridges and pheasants. The method is of greatest value when prior observations have been made. When a pair of birds or a female bird has been observed in the same place several times, or there is other indication that a nest may be near, special search for it is made.

Sheep, hogs, and cattle trample many nests, and it is well, therefore, to keep livestock out of some of the more favorable nesting cover. Where grazing of such cover is to be done, it is good practice to start it well in advance of the nesting season rather than turn stock into cover after nesting is well along.

BIRDS OF PREY IN RELATION TO WILD LIFE

There are so many kinds of hawks and owls, and their habits differ so widely, that it is impossible to classify them as a definite economic group. No wholesale destruction of hawks and owls, however, should be tolerated. Such destruction is not wild-life management, but ignorant or willful disregard of facts. There has been much misguided emphasis placed by people who should know better, on the destruction of everything that occasionally kills birds.

Game managers should get the facts concerning each particular area that is under control. Practically all predatory-game relationships must be determined as local problems—instead of county, State, or national—and the degree of control must be adjusted to local needs. Local conditions often prove markedly different when carefully studied, although to casual observation they may appear similar.

Every hawk and owl, except individuals actually seen destroying poultry or species that are consistently destructive, should have the benefit of intelligent consideration before its guilt or innocence is

decided. Owls have the habit of rolling all the coarser indigestible portions of their meals into compact balls, or pellets, and regurgitating them. Examining these dry rolls of bone and fur or feather is not at all offensive, and they afford a dependable check on the food habits of owls. Care must be taken, however, to identify correctly the owl that ejected them, if the observations are to have value as a guide to control policies in game management. Observation of the hawks and examination of their nests will show whether the birds are doing more good than harm.

The pellets of hawks are not so easily found nor so easily studied as those of owls. For judgment on hawks, it is necessary to consider the published results of general studies of stomach contents and to check these with impartial local observation, deciding the matter upon this basis. Hawks of nearly any species may at times prey upon song or game birds, but the vast majority exert a distinctly beneficial effect on game by controlling food competitors; by eliminating diseased and unfit individuals, which menace the good health of their fellows; and by keeping wild creatures alert and in sporting condition. Hawks and owls and other predators are probably necessary to top-notch fitness and alertness of game. Few sportsmen have any desire to shoot half-tame birds that have been reared in an environment where safety is always assured.

By and large, it is cheaper, easier, and better to improve the emergency game and songbird coverts on the farm than to undertake extensive control of winged predators, even where the need exists, except in the case of the great horned owl, and of the sharp-shinned and Cooper's hawks. When control is undertaken influx of predacious birds from other areas soon fills the vacancies. The yearly toll taken by predators on many game farms is almost constant, indicating that no real progress has been made even where wholesale control is attempted. It is impossible to control predacious forms on an effective scale, on most farms, by individual effort.

If control of these birds is necessary, directions for carrying out preventive and (in extreme cases) aggressive measures may be obtained in Leaflet 96, *Protecting Poultry from Predacious Birds*.

OWLS

When owls are present on a farm their roosts are not hard to find. In these, the owls often sit day after day, disgorging from time to time their pellets (fig. 15) of fur and bones. Literally bushels of mice are consumed by small owls, and these birds may well be called self-setting mousetraps; practically every night, and sometimes several times a night, their talons snap shut on mice. They should certainly have a chance to live. The screech owl (fig. 16) and the long-eared, short-eared, barred, barn, and saw-whet owls are all particularly valuable as rodent destroyers.

Great horned owls (fig. 17), however, are sometimes destructive to game, although at other times they eat many rats and pocket gophers. When they locate a chicken yard, they are likely to return to it night after night. This habit is almost confined to this one very large, ear-tufted species. Smaller owls should not be confused with these big fellows. Great horned owls, where really abundant, can be a decisive factor in determining the rate of increase of game, especially

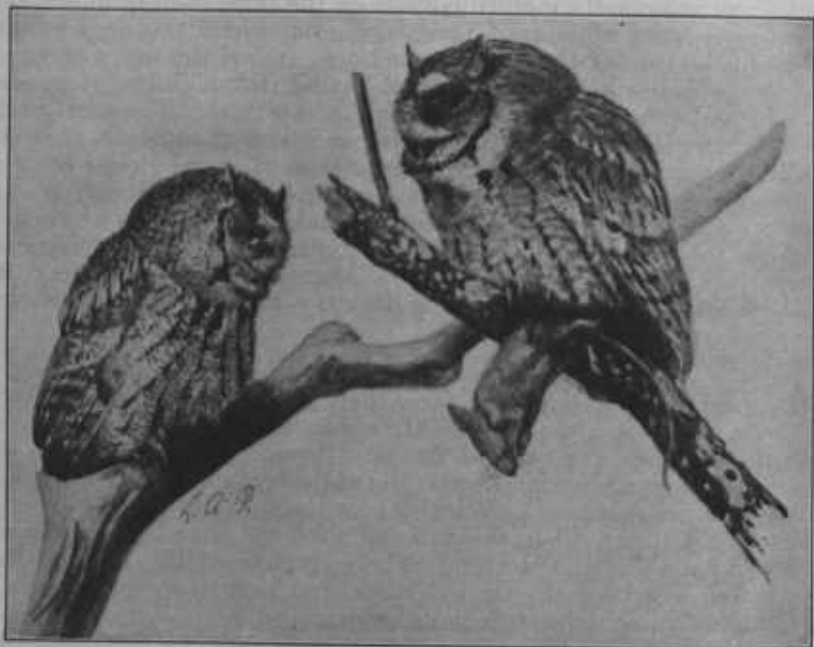
of rabbits. Whether this owl should be drastically reduced in numbers will depend upon the primary object of management. If rabbits are an object, this owl, if at all numerous, must be controlled.



B71M

FIGURE 15.—Field-mouse skulls taken from barn-owl pellets. The slaughter of birds doing this type of work is far from conservation.

In an orchard community, however, the great horned owl may be a blessing. It is a question for local determination. Where the pre-



B3795M

FIGURE 16.—Screech owls. These birds can well be called self-setting mousetraps.

ence of wild life in general is desired, the great horned owl may have partial protection, for there are few more picturesque or interesting birds. Under all ordinary circumstances owls of other species should

be left strictly unmolested. Much of the nest thievery so frequently blamed upon the smaller owls is the work of cats.

Effective control of great horned owls, where investigation indicates that it is warranted, includes the location of nests and the destruction of both adults and young. The owl ordinarily places its nest on an old crow nest, on a stub, or in a hollow tree before the snow has disappeared and while the trees are bare. In any case, large fluffy bits of owl down are usually to be found on twigs and branches for several rods about the nest site, and the presence of such down about the nest itself indicates its occupancy. Care should be taken not to confuse great horned owls with other owls of more beneficial habits. The practice of shooting into nests is vicious and destructive to many innocent creatures.

Nest hunting in March, together with the following up of late spring mobs of crows and jays, whose clamor often indicates the finding of an owl (care being taken in identifying the species) is effective; it reduces only the resident great horned owls, and is far preferable to the use of steel traps.

If it is necessary to use steel traps for great horned owls, it should be done only in the winter months, when there is a mini-

mum population of small birds that might be caught. To safeguard all innocent creatures the traps should be set late in the afternoon and unset early in the morning so as to limit their danger mostly to the hours of darkness. The killing of smaller birds can be obviated, in part, by setting the traps so that the lighter birds will not spring them. This can be done by regulating the depth in the notch to which the trigger of the trap is adjusted or by putting under the trap pan a twig, a special pan spring, a light coil spring, or a pad of cot-



B2796M

FIGURE 17.—Great horned owl. A powerful species, often destructive to game.

ton that will give under the weight of the large bird but not under that of smaller ones. (See also Leaflet 96, Protecting Poultry from Predacious Birds.)

The use of the indiscriminate pole trap should be earnestly discouraged. Pole traps kill songbirds and injure many useful birds of prey, and they frequently fail to catch the destructive types of hawks, which often alight in the woods instead of in fields, and in trees rather than on poles.

HAWKS

COOPER'S AND SHARP-SHINNED HAWKS

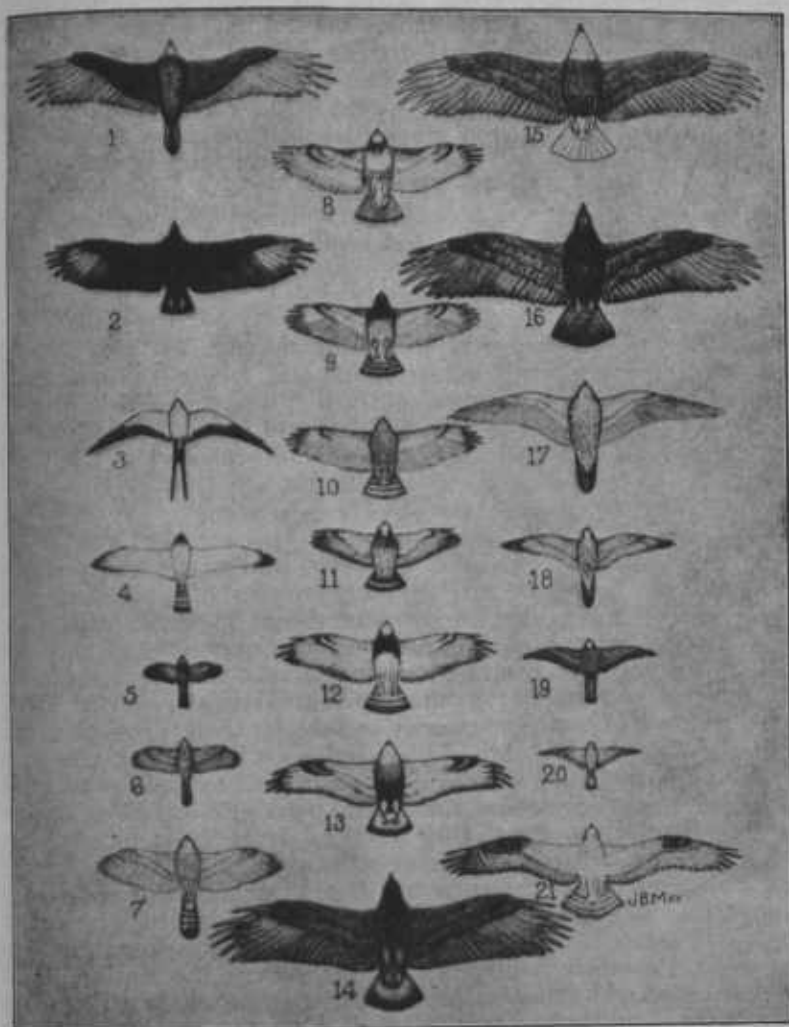
Cooper's and sharp-shinned hawks are so destructive to poultry and wild birds that it may be necessary to kill all individuals of these two species that can be found in the locality. Even so, control will rarely be fully effective, as these are the most elusive of hawks, but it can materially reduce their depredations. Practically all poultry and game-bird destruction can usually be traced to these short-winged and long-tailed, woods-loving, blue or brown "darters". They are rather small hawks (fig. 18, 5 and 6), being about the size of a pigeon, or smaller, but with more slender proportions and with longer tails. They do not commonly soar, but rather skim closely over cover and dart upon and seize their usually feathered prey in a most audacious way. They suggest the small scouting airplanes, and do not closely resemble the large, blimplike buzzard hawks, which soar high in the sky (fig. 18, 8-13) or sit conspicuously upon high perches. Cooper's and sharp-shinned hawks ordinarily are scarce in farmed country, as they prefer large wood lots, or even forest. The larger goshawk (fig. 18, 7), also of the darter group, which occasionally invades the northern United States during the winter months, preys extensively on game birds, especially on the ruffed grouse. It is of such infrequent occurrence, however, and so confined to woodlands, that it will rarely be encountered on farms.

MARSH HAWK

The marsh hawk (fig. 18, 4) should not be confused with the Cooper's and sharp-shinned hawks. Though much larger, it has somewhat the same proportions as the blue darters and also seldom soars, but both the wings and the tail are noticeably longer. It differs in coloration with sex and age, but can be recognized in any plumage by the conspicuous white patch at the base of the tail. This identification mark is easily seen while the graceful hawk beats slowly over meadows and fields, a few feet above the vegetation, in search of small rodents and birds. It preys upon meadow mice, pocket gophers, and ground squirrels, and upon some of the smaller marsh birds; but ordinarily it has no long-time detrimental effect upon game birds. As a rule, it should be protected.

SOARING HAWKS

The large soaring hawks have broader wings and tails than do the darters and the marsh hawk, and are slower in all their movements. With the exception of persistently destructive individuals,



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FIGURE 18.—Common predaceous birds, as seen from below in flight. The field identification marks have been accentuated to facilitate recognition.

- | | | |
|--|---|----------------------------|
| 1. Turkey vulture. | 8. Red-tailed hawk (adult). | 15. Bald eagle (adult). |
| 2. Black vulture. | 9. Red-shouldered hawk (adult). | 16. Bald eagle (immature). |
| 3. Swallow-tailed kite. | 10. Red-shouldered hawk (immature). | 17. White gyrfalcon. |
| 4. Marsh hawk (adult male). | 11. Broad-winged hawk (adult). | 18. Duck hawk (adult). |
| 5. Sharp-shinned hawk (small immature male). | 12. Swainson's hawk (adult). | 19. Pigeon hawk. |
| 6. Cooper's hawk (small adult male). | 13. Rough-legged hawk (immature light phase). | 20. Sparrow hawk (male). |
| 7. Goshawk (adult). | 14. Golden eagle (immature). | 21. Osprey. |

(From drawing by John B. May, reproduced by permission, from *Birds of Massachusetts and Other New England States*.)

they should be left in peace, as they feed chiefly upon mice and other rodents, and to a lesser extent upon insects, snakes, and frogs. The most common of the soaring hawks is the red-tailed (fig. 18, 8), often seen wheeling in circles high in the blue, above agricultural regions with wood lots or wooded river valleys. The red-shouldered hawk (fig. 18, 9) is also found in such places, but particularly in the denser woodlands. Both these hawks seem comparatively clumsy and glean their living from less agile creatures than upland game birds. Occasionally they are successful in picking up a cottontail or in catching a squirrel far from cover. The soaring hawks may safely be left unmolested in most agricultural communities, except for the occasional individuals that acquire destructive habits.

OTHER HAWKS

The little reddish-brown sparrow hawk (fig. 18, 20), a round-headed falcon often seen perched upon poles, where its characteristic tail-flirting movement is prominently displayed, has almost wholly beneficial habits. This is also true of the broad-winged (fig. 18, 11), the rough-legged (fig. 18, 13), and other comparatively rare hawks.

CONTROL OF PREDACIOUS BIRDS

The great horned owl, the Cooper's hawk, the sharp-shinned hawk, and the goshawk are the only species of predacious birds whose destruction is ordinarily warranted on game-management areas. Other hawks and owls eat enormous quantities of mice, rats, snakes, pocket gophers, and ground squirrels, and thus reduce the food competition faced by game species in critical periods. Predatory birds are of sufficient worth to justify their protection, both because of their beauty and of their influence in keeping game alert. Though the occasional individuals of almost any species of predacious bird that become destructive may be eliminated (for directions see Leaflet 96, Protecting Poultry from Predacious Birds), it might be well to concede to even hawks and owls a reasonable "bag limit" of game in return for their destruction of rodents and other pests. The hawk that eats several hundred mice, which otherwise would consume a great quantity of winter game-bird food, may even be said to have contributed more toward the welfare of the game than has many a sportsman, content to purchase a license and to destroy without in any way balancing his destruction by exerting any favorable or constructive environmental influence. Game may be given a large measure of protection against predatory forms, if adequate emergency coverts are provided, incorporating thorny tangles of dense vegetation with openings at the base.

Wholesale destruction of hawks and owls by side hunts or "vermin-killing" contests is never warranted. Groups contemplating organized destruction of predacious birds are urged to direct the same energy toward the development of adequate coverts; but if determined to conduct such campaigns, they are requested to make arrangements with the Bureau of Biological Survey for the preservation and analysis of all stomachs of the birds killed (and identified), in order that a scientific appraisal of the situation may be

made. Neglecting to utilize such opportunities for increasing the stock of real knowledge of predators shows prejudice of a sort that is likely to defeat progress in wild-life management. Destruction of any form of wild life without due consideration of pertinent facts may be highly detrimental to game management.

CATS AND DOGS AS GAME DESTROYERS

In well-settled communities the house cat is probably the greatest single agency of game-bird and songbird destruction. Cats have been observed to eat eggs just prior to hatching, locating the nests by the calls of young birds yet in the shells. It is well known that a cat will capture young songbirds in their nests, often just when they are ready to take flight. Cats also eat young rabbits and kill incubating quail, partridges, and prairie chickens on their nests. Cats will even kill more than they consume, playing with many birds they do not eat.

For some of these things the house cat may be forgiven on the ground that cats must live according to their instincts and because they are valued as pets and render some service in destroying mice and other rodents. The number of cats must be kept down, however, if wild-game farming is to succeed, and the farmer who wishes to increase the abundance of game and song birds will see to it that certain common practices relating to cats are not allowed on his farm.

The first is the keeping of more cats than are needed. Some farms have 8 or 10 cats, when 1 or 2 would do just as well. The numerous cats frequently wander all over the countryside, taking up residence for a time on one spot, and then moving elsewhere. Stray cats are a menace to wild life and, if the law permits, should be shot on sight.

Another practice, that of allowing cats entire freedom at night and early in the morning, enables them to hunt at the time they can be most destructive. Every farm cat should be locked in a granary, storeroom, or other place where it can do some good, or at least no harm, at night and in the early morning, instead of being permitted to roam the fields. Most farmers are unaware of the wide excursions made by their cats, often thinking the cats are fast asleep in the haymow or granary when in reality they are on the prowl, ravaging communities of songbirds and disrupting coveys of game birds. Directions for trapping stray cats are published in Leaflet 50, *How to Make a Cat Trap*.

There is a habit among some unthinking townspeople of taking unwanted cats into the country in sacks and dumping them near farmyards. Such persons can usually be apprehended under State or municipal humane laws for wanton neglect of dumb animals. The practice is vicious in its effects upon wild life, as it often forces cats to make their living off the country. It will bear repeating that any stray cat should be killed.

Dogs, also, do some damage to game but are less able than cats to kill any but young birds. Dogs should be kept out of game coverts during the nesting period; at other times they should not be allowed to range in the coverts, except under supervision for training or for hunting purposes. Dogs are relatively harmless, however,

as compared with cats, and although they may chase game, they seldom capture it. Furthermore, most dogs are duly licensed and carefully taken care of by owners.

PREDATORY WILD ANIMALS ON GAME-MANAGEMENT AREAS

Ordinarily on farms the problem presented by fur animals, which prey more or less on other forms of wild life, solves itself where there are energetic boys. The bulk of America's skunk pelts, for instance, in normal times worth several millions of dollars yearly, are taken by farm boys. These pelts are an asset on most farms, and consequently the animals should themselves be managed for a sustained yield. Furthermore, it is well known that many fur animals feed upon mice, ground squirrels, and insects, so that from that point of view, also, they may be regarded as economically beneficial and should be maintained in reasonable numbers.

Some difficulty is experienced, however, on refuges, where no trapping is permitted. Under such circumstances, predatory animals and fur bearers may increase unduly and defeat any preferential treatment desired for game. Reasonable trapping is sometimes necessary in game management. In the cooperative quail investigation a decided reduction in nest mortality and a consequent increase of quail were obtained by trapping skunks and other fur animals on preserves previously closed to all trapping.

In regions where farm-game management may be interfered with by the presence of coyotes or other predatory wild animals, measures should be taken to bring the predators under control. Recommendations as to methods may be obtained from the Bureau of Biological Survey.

The object of wild-life management, in general, should be to bring about an increase of all forms of desirable wild life, including fur animals, rather than to exterminate one group for the supposed benefit of another. It is not desirable to have a farm either overpopulated with fur animals or barren of them. With proper abundance and distribution of cover, and with an ample food supply, it should be possible to obtain a simultaneous increase not only of game, but of most hawks and owls, of a majority of the small fur bearers, and of practically all songbirds normally found on the land. In fact, many hunters and farmers recall finding a great abundance of song, game, and insectivorous birds as well as of fur animals and predacious birds in some favored locality at the same time. This demonstrates again the importance of coverts. Some predatory-animal control fails to increase game because no corresponding improvement of coverts is attempted.

A combined crop of fur and game can be harvested on a great many farms where one alone would not be particularly profitable. As byproducts of the American farm, each deserves careful consideration. Many farms are producing excellent fur crops. On others the environments necessary for fur animals have been destroyed or the seed stock has been trapped out. Due attention to these factors is necessary.

In all cases, both farmer and game manager should be familiar with the predatory-animal population on the managed area, and any

time that an undue increase of fur bearers is indicated, plans should be made for relieving the situation. The aim should be to trap fur animals during the prime-pelt season, allowing them almost complete protection at other times, except when they threaten definite destruction. It should be borne in mind that most of them are protected by law except during a specified open season.

Fur and game farming offer possibilities to farm boys, who will be interested in publications of the United States Department of Agriculture on these subjects, lists of which will be furnished on request addressed to the Bureau of Biological Survey.

INFECTIOUS AND PARASITIC DISEASES

Diseases, including those caused by parasites, sometimes play an important part in reducing the ranks of certain birds and animals. For some no control measures have as yet been devised; others may be partially held in check. Usually, the devastating spread of most diseases implies a dense population of birds or animals. In other words, if there is one game bird for every 40 acres, the chance for quick transmission of parasitic and other diseases is relatively slight; if on the same area there are two birds to the acre, the chances are increased by the more frequent close contacts of individuals. It is theoretically possible, therefore, to have too many birds or animals on a given area at one time. In fact, this is exactly the difficulty experienced on game farms and game-propagation plants at certain times. It has even been suggested as a reason for the sudden "die-offs" of ruffed grouse and snowshoe rabbits under natural conditions in the North.

Overpopulation is undesirable also from other points of view, and reasonable hunting may actually be necessitated as a disease-control measure. Certain it is that any animal species can become too numerous for its own welfare; the approach of this condition calls for hunting or some other form of elimination.

Preventing disease and the spread of parasites is to some extent feasible on farms, as some diseases and some parasites are transmissible from poultry to game birds, and even vice versa. For this reason, on game-management areas poultry should not be allowed free range. Turkeys and chickens, especially, should not range through game coverts. Poultry manure should not be spread over the fields promiscuously, unless the ground is to be plowed immediately. The bodies of dead birds should be burned or buried, not thrown on the manure heap for later distribution to fields and game ranges.

Diseases and parasites do not ordinarily destroy much farm game if their eliminative processes are allowed to take their course. Usually, in the wild state, it is not necessary to be particularly concerned about disease. The aim should be to promote the general good health of birds and animals by making plentiful food and coverts available and by encouraging all factors that keep wild things alert and healthy.

Should diseased birds or animals be encountered, however, the condition may be described to the Bureau of Biological Survey,

Washington, D.C., and if further investigation is needed, this organization will furnish instructions for preserving and shipping specimens.

REGULATING HUNTING ON GAME-MANAGEMENT AREAS

It is needless to state that illegal hunting must be stopped on game-management areas and legal hunting adjusted to the game supply; that is, in areas where the legal bags permitted are larger than the supply justifies, hunting should be kept within reasonable limits. There are occasionally cases in which the available game supply might warrant a much larger bag and a much longer season, and these will become increasingly numerous under a widely practiced system of game management. To this end legislation should take into account the farmer's efforts in behalf of game. Flexible administration of seasons and bag limits, based on the actual supply and on the degree to which coverts and food resources have been developed, should be sought, rather than inflexible legislation.

Several Northern States have suffered severe diminution of their quail stocks, even with open seasons of but a few days and with restricted bag limits, whereas in several Southern States a very decided increase in the numbers of quail found on heavily hunted preserves has accompanied liberal bag limits and seasons 3 and 4 months long. The difference between these two extremes lies in intelligent game management. Legislation should be so framed as to furnish an incentive to practice game management. On two properties, side by side, one owner may provide food, increase coverts, afford protection from the worst enemies, and obtain an increase of birds, while at the same time his neighbor, by cultivating every foot of his property, exterminates game. Legislation that grants these two men equal privileges as to taking game does not encourage further planned management for the increase of game.

One State has already initiated what is known as the differential seasons system, and provides a longer season for lands on which propagated pheasants are released. The principle is entirely sound and might well be extended to all species that respond to management, rather than restricted to those that can be reared by hand. The total kill should always bear a reasonable relation to the population, however. Under the British system, for instance, the number of game animals that may be taken from an area is definitely limited in advance.

Hunting problems are too often considered as country-wide or statewide when they may really be only farm-wide. It is unwise to enact laws permitting the killing of game on all lands within a large political division regardless of the fact that on many farms within that area there is little or no game. Equally unwise is it to close entire counties or States to hunting when it is obvious that certain farms have abundant supplies of game that are well taken care of by the landowners. Without game management, it may be too much to allow the killing of 1 percent of the birds. Under intelligent management, it may be possible to kill 50 percent of the adult game without detriment to the permanent stock.

Certain kinds of game endure a much heavier rate of kill than others. Cottontail rabbits, for example, stand heavier hunting than will prairie chickens. The degree of hunting that a specific farm can safely afford must be worked out on the basis of local information. To this end, it is important for each farmer to make a game survey of his farm-game resources, to keep accurate records of all hunting done there, and to note down the kills resulting. Only by means of accurate year-to-year comparisons can the game crop be harvested on an intelligent basis.

HOW TO MAKE A FARM-GAME SURVEY

This bulletin has thus far discussed some of the broader relationships of farm environment to wild life. Each farmer or game manager must himself appraise the conditions on his own premises. Not only should he know the situation as to numbers and kinds of birds and animals at the start but it is necessary that he keep records of either stable or changing conditions over a considerable period of time. Chance circumstances may favor an excellent crop of birds one year, but less fortunate conditions may greatly reduce the supply the next. It is most desirable, therefore, for each game manager to institute and maintain a farm-game survey. This survey should be continuous, or repeated at intervals of a few months, and should take into account all those factors that operate for or against wild life on the farm and are subject to control. Since food and cover are fundamental and lend themselves to management, the farm-game inventory should give them particular attention.

MAKING A MAP OF THE FARM

To aid in the farm-game survey, it is desirable to have at least a rough map of the farm. This should show locations of creeks, buildings, woods, fences, and other common features, in addition to fields in crops. It is well to prepare a new map each year in order that the effect of continued or modified practices may be apparent. The work of mapping is really fascinating and will bring out interesting details of bird and animal localization that are not at first obvious. The wild life found on the farm can be shown on the map with surprising accuracy. The map need not be elaborate. An ordinary sheet of paper will be sufficient for each 10 to 40 acres, or other definite unit. Sketch maps of a farm, before and after alterations were made in favor of wild life, are presented in figures 19 and 20, illustrating a simple but useful type of map.

ENUMERATING AND PLOTTING THE GAME

With the map as a basis, and each square designated by a number, a list may be made of all the varieties of birds and animals found on the farm, and on each of its subdivisions, or of those that have some particular interest. An estimate can be made as to numbers by using sight records, or by taking tracks, dust baths, calls, nests, or other signs as the basis after some unit of measurement has been approximated. In table 3, a sample blank for a wild-life inventory chart,

the first column is used for the species; the second for its estimated numbers; the third for its location, using the number of the square on the map; and the last column for an entry showing whether, in the opinion of the enumerator, a particular species is stationary, increasing, or decreasing.

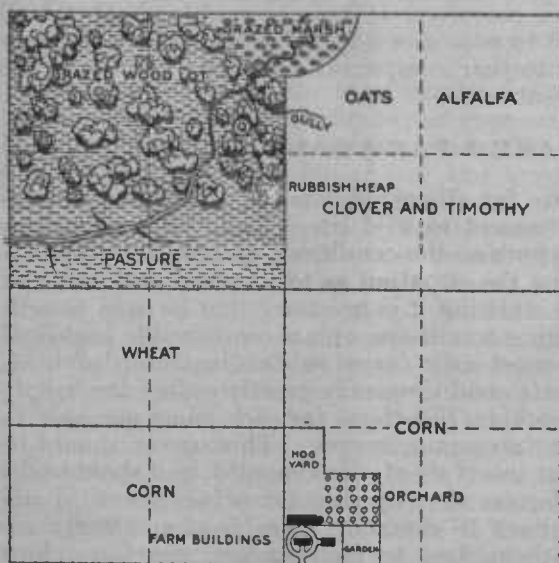


FIGURE 19.—Map of a 160-acre Corn Belt farm before it was improved for wild life. (See also figure 20.) Hogs use orchard in foreground; no trees on lawn about farm buildings; only one covey of quail (Q in circle) on farm.

The situation having been appraised in this way, reference to the map and to the list of farm practices in relation to game (pp. 42-44) should be made to determine, if possible, the main factors that limit the further increase of the species. Often there will be found significant differences in the wild-life productivity of various portions of the farm, and these differences should be examined for possible correlation with causative factors.

TABLE 3.—Sample blank for wild-life inventory chart

Species	Estimated numbers	Map square	Status ¹	Species	Estimated numbers	Map square	Status ¹
Birds:				Birds—Continued.			
Bobwhite quail.....						
Prairie chicken.....				Mammals:			
Ruffed grouse.....				Cottontail rabbit.....			
Hungarian partridge.....				Snowshoe rabbit.....			
Ring-necked pheasant.....				Squirrels.....			
Woodcock.....				Raccoon.....			
Jacksnipe.....				Opossum.....			
Wild ducks.....				Skunk.....			
Crow.....				Mink.....			
Great horned owl.....				Weasel.....			
Small owls.....				Red fox.....			
Cooper's hawk.....				Gray fox.....			
Soaring hawks.....				Wild house cat.....			
Marsh hawk.....				Muskrat.....			
Sparrow hawk.....				Coyote.....			
Woodpeckers.....				Pocket gopher.....			
Orioles.....				Mice.....			
Robin.....				Rats.....			
Bluebird.....				Woodchuck.....			
Brown thrasher.....						
Mourning dove.....						
House wren.....						

¹ Indicate by number; see figs. 19 and 20.

² Stationary, increasing, or decreasing.

CHECKING UP ON COVER AND OTHER FACTORS

After showing on the map the areas of cover and food, it is well to make a summary of the findings, to facilitate consideration of improvement methods. As a start in checking up the cover resources of the farm in a definite way the following schedule may be used as a guide:

SCHEDULE FOR SUMMARIZING RESULTS OF FARM-GAME SURVEY

Indicate for each of the following coverts on the farm the approximate acreage (or length) and the grazing condition (the condition of these areas with respect to grazing may have a great effect upon their value as wild-life cover):

Grassy marsh or swamp
Wooded swamp
Wood lot
Orchard
Vineyard
Berry patches
Garden
Fallow fields
Pond or lake
Windbreaks
Grassy fence rows
Brushy hedgerows
Creeks and rivers
Eroded gullies
Very rocky land
Hilly land
Isolated land
Unproductive soil

State which of the above types can best be put to the growing of trees, game, and fur, instead of continuing under present use.

State which can be profitably extended.

Note where windbreaks would be of assistance in checking erosion, preventing lodging, and conserving moisture.

Indicate quantity of standing or shocked corn available for game. Is it well located in relation to cover?

State which of the following foods are found in abundance and which should be increased:

Wild grape
Virginia creeper
Bittersweet
Elderberry

Dogwood
Wild cherries
Wild raspberries
Ragweed

Amaranth
Lambsquarters
Others

List the most serious enemies of wild life on the premises.

Check up on the number of cats, especially strays. Are there too many? Are they confined at night?

List the species of game killed during the last open season and the numbers of each. (This item should be given careful consideration. All hunters should

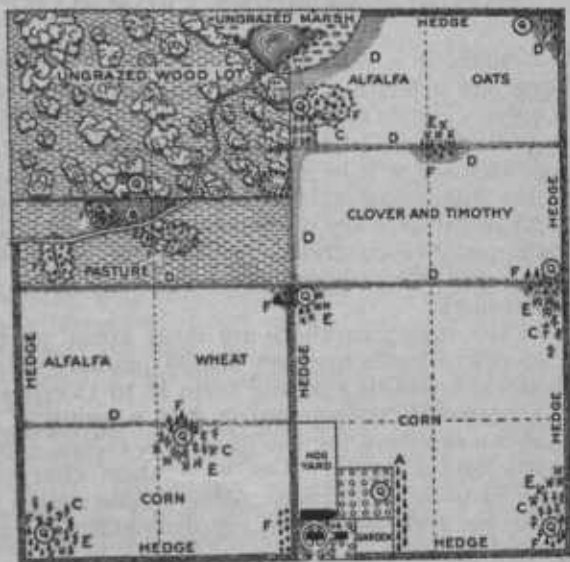


FIGURE 20.—Map of farm shown in figure 19, after it had been improved for wild life. Woods and marsh fenced and ungrazed; pond constructed in marsh; rubbish heap surrounded by trees; gullies planted; orchard protected from hogs; trees planted on lawn; wheat acreage decreased and alfalfa acreage increased to offset woods formerly grazed: A, Windbreak round buildings; B, millet patch; C, standing corn feed patch; D, hay strip left standing; E, shocks of corn left in field; F, cover patches—low spruces, large thorny roses, grapevines, sumac, bay. Numerous quail coveys now on farm.

be required to report game bagged on the premises, and a written record should be kept by days, by number of hunters, and by seasons.)

List the species of fur animals trapped on the farm and the numbers of each. (Records similar to those of the game animals should be kept for the fur bearers.)

Other methods of determining the present game-carrying capacity of the farm and what to do to increase this capacity will suggest themselves and should be recorded in the summary. Consideration of the various farm practices discussed elsewhere (pp. 42-44) may suggest a convenient method of further checking up on the wild-life situation.

POSSIBLE RETURNS FROM GAME MANAGEMENT

Usually it is necessary to consider the purely economic aspects of proposed activities in game management, particularly where these involve a choice of one land use or another. Regardless of the actual or potential use of the land, taxes and upkeep go on. For this reason, farmers will be interested in learning how improvements made in the interest of wild life are paying their way. Methods of payment to farmers are discussed on pages 59 and 60, but the following instances give concrete evidence that game, though new as a farm crop deliberately encouraged, has worth-while possibilities as a source of income:

In the aggregate there are large areas, particularly in the Southeast, where lands are now leased primarily for the shooting rights, customary rentals running from 10 to 15 cents per acre.

An association cooperating with a group of ranchers in California paid the ranchers for use of horses, riders, camping outfits, supplies, board, and lodging. The association charged daily fees, ranging from \$1 to \$2.50 and amounting in one season to \$3,060, and used its funds for restocking, for supplemental feeding, and for control of natural enemies.

In Texas landowners must be licensed to sell shooting rights, and the fee is limited to a maximum of \$4 per day, or to 25 cents per acre under leases.

A similar plan is in effect in North Carolina with organizations controlling 3,000 acres or more.

In Iowa 7 farmers with approximately 4,000 acres of land recently established a game-management area in cooperation with a chapter of the Izaak Walton League. During the 1932 shooting season, when hunters were charged 50 cents for each bird shot, one farmer received \$24.50, another \$10.50, and a third \$3.50. The others had allowed friends to shoot without paying or had had no game taken.

In Ohio 28 farmers on an area of 11,000 acres under central management have charged \$2.50 for hunting permits for the area. During the fall of 1931, under this system 200 hunting permits were issued, bringing a revenue of \$500.

In Michigan farmers joining "hunting exchanges" are aided in control of trespass, and hunting tickets, limited in number, can be obtained only at farmhouses. Licenses for shooting preserves also are issued, requiring the propagation and release of 100 or more game birds and providing for the sale of hunting rights.

Wisconsin has a law similar to that of Michigan.

In Nebraska coupons sold by the State game commission may be paid out for hunting privileges to farmers registered with the commission. These coupons, of a value of 50 cents for each pheasant, are redeemable by the commission or, in actual practice, by banks or business men locally.

THE FARMER'S PART

In considering the possibilities of returns from game management three things are to be borne in mind: (1) Any sound system must preserve adequate seed stock for the next breeding season, with a margin sufficient to absorb both winter and hunting losses; (2) it must so limit the kind and the extent of hunting as not to drive all the game out of the managed area; and (3) it must reduce all abuses to the minimum.

The whole object of sport is recreation, and to this end hunting should be made difficult. It is neither true sportsmanship nor recreation to shoot birds that have no escape from sure death before the most modern of firearms and with few or no factors in their favor. The aim in developing areas for sport should be to arrange coverts to the advantage of the game and thus make hunting so difficult as to demand skill and effort on the part of the sportsman. The most enjoyable hunting is in localities where game is abundant enough to afford many glimpses of it, but where it is difficult to obtain a reasonable day's bag, because the odds favor the game and not because game is scarce. Frequent and well-placed coverts are the best means to this end.

In providing accommodations for hunters each season, farmers will do well to give preference to those who are more interested in sport than in bag limits. Not only should farmers see that the legal limits are enforced, but where these are too large for local conditions on his farm, he should prescribe a lower farm limit. To reduce waste of game, it is well to have available one or more good retriever dogs.

METHODS OF PAYMENT

EXCHANGE OF SERVICES BETWEEN SPORTSMEN AND FARMERS

The exchange of services between sportsmen and farmers usually is arranged in such manner that neither of the parties receives actual financial profit, but each enjoys benefits. In return for privileges granted him the sportsman frequently supplies stocks of birds not previously found on the premises, often furnishing these at considerable expense; or he may provide planting material for cover and food purposes on poorer lands; or pay the taxes on better lands that can be managed for game but otherwise would be utilized for the more usual cash crops. The farmer enjoys an increased game supply for his own use and is relieved of the burden he formerly assumed of paying taxes on unproductive lands.

This kind of relationship is worthy of wide employment. It has, in fact, been entered into on a large scale in Michigan. The exchange-of-service system is sound in that both parties to the bargain

have a definite incentive to preserve and increase the game supply. Such efforts result also in a great increase of fur animals and other forms of valuable wild life that make use of game coverts.

RENTALS

Leasing is a natural outgrowth of the exchange-of-service system, and is usually arranged on the basis of paying a small profit to the farmer above his actual expenses, including taxes, interest, and improvements. Leasing in the past has been mostly to individual sportsmen or clubs, but the system is being developed of late by large organizations of sportsmen dealing with farm groups.

ENTERTAINMENT AND ASSOCIATED PROFITS

The farm that has scenic advantages as well as game may adopt the resort system, which is particularly applicable there. It involves the provision of lodging and services at a profitable rate, the farm's wild-life resources serving as the main attraction to visitors. This system is practicable even for small-farm game management if practiced in such manner as to insure a continuing supply. Many resorts in the past have taken advantage of the natural situation, but have failed to do anything constructive toward maintenance of wild life or improvement of hunting facilities.

DAILY TOLLS

The daily-toll system is in more or less common use in the vicinity of cities, where hunters are numerous and game lands scarce, or where unregulated hunting has been accompanied by intolerable abuses. This system appeals to sportsmen who have no opportunity for leasing hunting grounds or making other permanent arrangements but wish, nevertheless, an occasional half day's hunt over well-stocked and readily accessible coverts. Under this system great care must be taken, however, not to permit reduction of the seed stock. The number of hunters must be strictly regulated, and bags must be in proportion to the game population.

PARTNERSHIP EARNINGS

That system of game management and marketing in which the hunter, as well as the landowner, has a tangible and lasting interest in land improvements made for game is the system most likely to succeed in a permanent way. Without this interest, too many hunters think only of the present day's hunt, and have no regard for preserving sufficient stock for tomorrow and for future years. In the end, then, successful game management is likely to resolve itself into partnerships between farmers and hunters, involving profit to both, rather than into systems dependent upon the sale and purchase of rights only. In fact, the test of successful game management is not whether more game is bagged, but whether, in addition, there still remains more game in the coverts than before management was undertaken. If game management accomplishes this, it is sound; if it does not, it is unsound and will terminate with the extermination of the game.

ESTHETIC RETURNS

Wild-life management has been here referred to primarily as a game-production undertaking, with purposes more or less specific and even mercenary. Its benefits, however, involve species other than game, for bettering game coverts invariably aids wild life in general. This is game management's contribution to the enjoyment of all wild life by the general, nonhunting public.

To most farmers the principal rewards from game management will be those pleasures that they and their families derive from the beautification of the farm and from the presence of a variety of living things. The melodious songs and incessant activities of birds, the drama of the lives of wild things, the companionship that animals somehow give to man—these are among life's real and lasting experiences. Such associations are a profound part of man's attachment to the soil, and are eminently worth preserving for their own sake.

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